AD-A099 863 NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER ATL--ETC F/G 1/2
LOS ANGELES INTERNATIONAL AIRPORT DATA PACKAGE NUMBER 10, AIRPO--ETC(U)
JUN 80

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LOS ANGELES INTERNATIONAL AIRPORT

DATA PACKAGE ~~NO.~~ Number 10

AIRPORT IMPROVEMENT TASK FORCE DELAY STUDIES.

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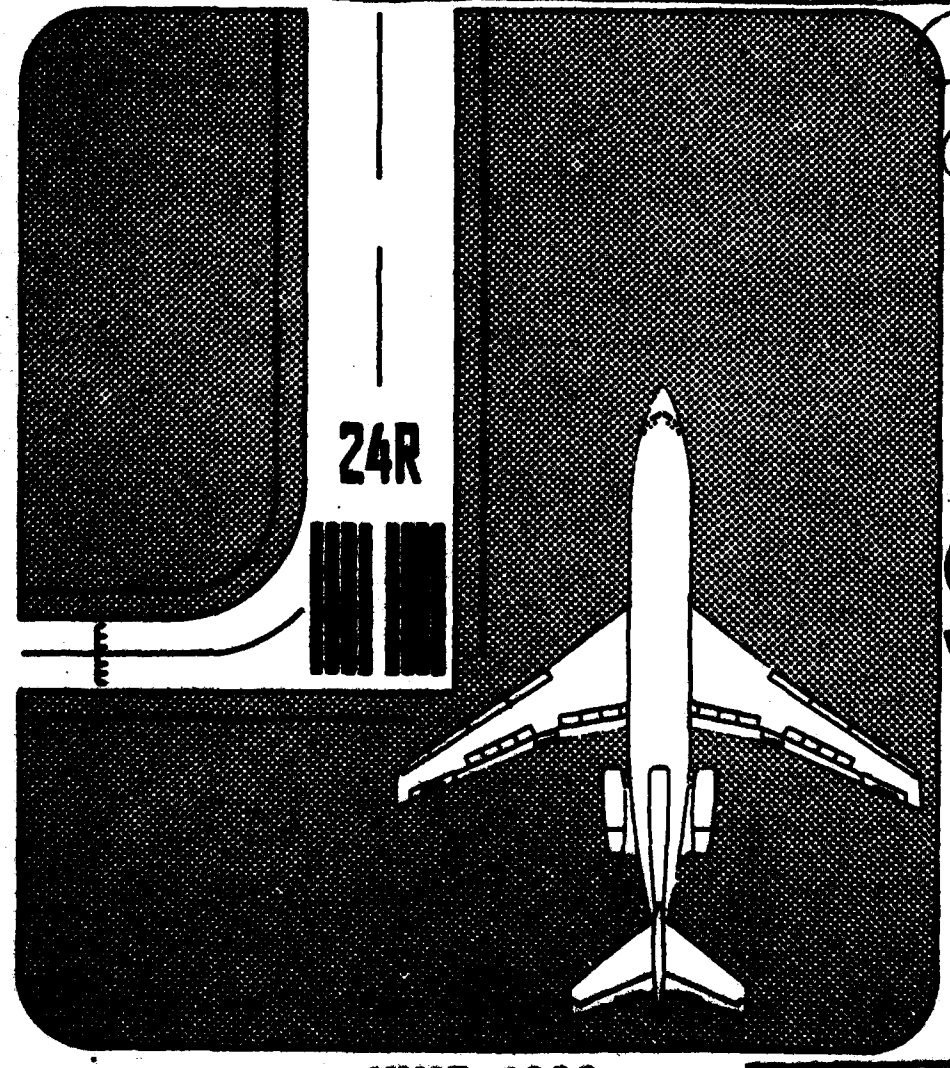

JUNE 1980

DATE: July 18, 1980

SUBJECT: Revisions for LAX Data Package No. 10

FROM: John Vander Veer, ACT-220

TO: Members of the Los Angeles Task Force

Enclosed are the revisions for Los Angeles International Data Package No. 10. The replacements are for pages 23, 25, 40, 46, 47, 55, 56, 59, 60, 64, 65, 69, 77 and 78.

The changes in annual delay were the result of a miscalculation and the other changes were the result of transcription.

John R. VanderVeer

John Vander Veer

TABLE 9

RESULTS OF VFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
1	1978	—	—	NONE	1978	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
→ 7	1982	—	—	NONE	1978	634	57	61	2598	562	8	30	3336	4027	1610	5659	11296
7A	1982 +5%	—	—	NONE	1978	1576	66	119	4182	897	4	293	5562	5123	1708	7905	14736
7B	1982 +15%	—	—	NONE	1978	5671	226	105	5541	1591	4	1118	8587	9339	1907	10884	22130
11	1982	—	—	NEAR TERM	1982	1358	123	108	4130	1357	4	1133	6856	4709	1681	8897	15287
→ 11	1982	—	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	1982	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
13	1982	—	—	BY-PASS TO RUNWAY 24R, HOLDING AREA ON TAXIWAY 7E	1982	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742
18	1982	—	—	DUAL TAXIWAY	1982	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
18	1982	—	DEPARTURES SENT FRIM 25R TO 24R	DUAL TAXIWAY	1982	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
18A	1982	—	"	DUAL TAXIWAY	1982	409	55	62	2190	659	10	3	2980	3748	1629	5175	10552
19A	1982	—	—	TERMINAL EXPANSION	1978	525	39	45	2346	424	8	12	2873	3823	1586	5151	10560

→ = REVISION A, 7/18/80

TABLE 10

RESULTS OF IFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
2	1978	—	—	NONE	1978	8235	26	56	2170	100	3	69	2424	11024	1324	4524	16871
→ 2*	1978	45 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	4414	35	60	2895	128	4	315	3437	7610	1548	5597	14755
3*	1978	11	—	NONE	1978	7009	1054	84	9535	241	5	5305	16222	9970	2546	16754	29270
→ 8*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
8A*	1982 +5%	53 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	7945	36	56	3777	170	1	416	4456	11191	1573	6774	19539
8B*	1982 +15%	61 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	12703	81	56	5442	297	2	2285	8163	16030	1648	10600	28277
→ 12	1982	50 ARRIVALS ON 25L CHANGED TO 24R	—	NEAR TERM	1982	5046	55	54	2373	165	3	223	2874	8279	1594	4810	14682
12*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982	2321	50	58	2713	189	6	290	3307	5406	1665	5944	12515
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	131	17	5292	331	7	4318	9948	7353	1757	11343	20452
24	1982	—	—	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5967	108	18	6327	177	0	3112	9741	9595	1893	11386	22874
24	1982	—	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5043	173	20	6020	394	0	4872	11479	8626	1911	13505	36557

* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED

→ = REVISION A, 7/18/80

TABLE 14 (CONTINUED)

1978 OPERATIONS WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
2*	1978	45 ARRIVALS ON 25L CHANGED TO 24R		NONE	1978 (IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5597	14755
8*	1982	35 ARRIVALS ON 25L CHANGED TO 24R		NONE	1978(IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
RESULTS: The 1982 demand resulted in greater arrival delays and reduced departure delays.																	
5*	1978	ALL ARRIVALS PLACED ON 6R		NONE	1978(IFR)	1245	4	0	1130	5	0	0	1139	2142	466	1647	4255
10A*	1982	"		NONE	1978(IFR)	2648	4	0	1285	13	0	0	1302	3001	497	1835	5323
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																	

* = Modified Demand

← = REVISION A, 7/18/80

8A

TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
1	1978	—	—	NONE	1978(VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
→ 7	1982	—	—	NONE	1978(VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
7A	1982 +5%	—	—	NONE	1978(VFR)	1576	66	119	4182	897	4	293	5562	5123	1708	7905	14736
7B	1982 +15%	—	—	NONE	1978(VFR)	5671	226	105	5541	1591	4	1118	8587	9339	1907	10884	22130
→ 2*	1978	45 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5397	14755
→ 8*	1982	53 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
8A*	1982 +5%	53 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	7945	36	56	3777	170	1	416	4456	11191	1573	6774	19539
8B*	1982 +15%	61 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	12703	01	56	5442	297	2	2285	8163	16030	1648	10600	28277

RESULTS: The 1982 DO-NOTHING CASE resulted in progressively higher arrival and departure delays as the demand was increased by 5% and 15%.

← = REVISION A, 7/18/80

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DAYTIME DELAY DEPARTURE
→ 1	1978	VFR	NONE	1978	5.3	12.7
7	1982	VFR	NONE	1978	3.5	9.5
7A	1982+ 5%	VFR	NONE	1978	9.9	13.8
7B	1982+15%	VFR	NONE	1978	35.7	16.9
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
8A	1982+ 5%	IFR	NONE	1978	45.8	12.1
8B	1982+15%	IFR	NONE	1978	65.1	19.0

→ = REVISION A, 7/18/80

TABLE 20

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
→ 7	1982	—	—	NONE	1978 (VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
→ 11	1982	—	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	1982 (VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival and departure delays.																	
9*	1982	43 ARRIVALS CHANGED FROM 7R TO 7L TOSS	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3302	3985	1595	5072	10652
16*	1982	"	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982 (VFR)	332	76	62	2271	309	13	65	2795	3898	1602	4818	10319
RESULTS: The high speed exits, runway 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.																	
→ 8*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5700	39	63	2714	164	5	304	3288	8324	1578	5388	15470
12*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982 (IFR)	2321	50	58	2713	189	6	290	3307	5406	1665	5444	12515
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival delays.																	

* = Modified Demand

→ = REVISION A, 7/18/80

55A

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DAYTIME DELAY DEPARTURE
7	1982	VFR	NONE	1978	3.5	9.5
11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
8*	1982	IFR	NONE	1978	26.6	10.0
12*	1982	IFR	NEAR-TERM	1982	25.5	8.3
→ 12**	1982	IFR	NEAR-TERM	1982	13.1	9.9

* = Modified Demand

** = Rerouted Departures

→ = REVISION A, 7/18/80

TABLE 23

1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
1	1978	—	—	NONE	1978(VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
2S	1987	—	—	FAR TERM	1987(VFR)	189	34	32	1325	245	1	2	1639	3720	1452	3519	8692
2SA	1987 +10%	—	—	FAR TERM	1987(VFR)	257	40	38	1957	415	1	73	2524	3899	1505	4455	9859

RESULTS: The FAR-TERM improvements and 1987 VFR separations resulted in substantial reductions of arrival and departure delays.

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
→ 2*	1978	45 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5597	14755
2G	1987	—	—	FAR TERM	1987(IFR)	831	23	35	1923	88	2	79	2150	4392	1517	4010	9920

RESULTS: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.

* = Modified Demand

59A

→ = REVISION A, 7/18/80

TABLE 24

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DAYTIME DELAY DEPARTURE
→ 1	1978	VFR	NONE	1978	5.3	12.7
25	1987	VFR	FAR-TERM	1987	0.6	5.0
25A	with 1987peaks	VFR	FAR-TERM	1987	0.9	7.9
2	1978	IFR	NONE	1978	25.7	12.5
26	1987	IFR	FAR-TERM	1987	4.6	7.0

→ = REVISION A, 7/18/80

TABLE 26

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
→ 7	1982	—	—	NONE	1978 (VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (VFR)	993	233	19	4200	1450	11	944	6857	4903	2100	9082	15586
22A	1982	—	"	RUNWAY 25R TUNNEL CONSTRUCTION WITH DUAL TAXIWAY	1978 (VFR)	1034	187	16	4071	1359	11	1048	6694	4444	2101	9001	15547
* 35	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (VFR)	969	65	10	2925	800	0	50	3849	4340	1653	6159	12153
RESULTS: Experiment #22-- Runway 25R tunnel construction resulted in larger departure delays (about 56%). Experiment #22A-- The availability of the dual taxiway system during tunnel construction reduced the taxi delays. Experiment #35-- Runway 25L tunnel construction after the completion of runway 25R resulted in less delay compared to the delays during the tunnel construction on runway 25R (Experiment #22).																	
→ * 8	1982	50 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (IFR)	4776	131	17	5292	331	7	4318	9948	7353	1757	11343	20452
* 36	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (IFR)	6297	81	14	5375	344	0	3339	9153	9319	1527	11028	21873
RESULTS: Experiment #23-- Runway 25R tunnel construction resulted in larger departure delays during IFR weather. Experiment #36-- Runway 25L tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #23.																	

* = Modified Demand

→ = REVISION A, 7/18/80

TABLE 26 (CONTINUED)

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
→ * 8	1982	5% ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
24	1982	—	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978 (IFR)	5043	173	20	6020	394	0	4872	11479	8626	1911	13505	36537
* 37	1982	5% ARRIVALS ON 25L CHANGED TO 24L	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION (25L COMPLETE)	1978 (IFR)	6535	95	15	5493	328	11	3512	9454	9719	1696	11664	23079

RESULTS: Experiment #24-- Runway 25L tunnel construction resulted in larger departure delays during IFR weather.
(Experiment #24 compared to Experiment #23 indicated that the construction of runway 25L produced larger delays than the initial construction of runway 25R.)
Experiment #37-- Runway 25R tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #24.

→ = REVISION A, 7/18/80

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TABLE 27

IMPROVEMENT COMPARISONS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
→ 7	1982	—	—	NONE	1978 (VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
18	1982	—	—	DUAL TAXIWAY	1982 (VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
RESULTS: The dual taxiway system and the 1982 separations resulted in reduced arrival delays. No change was noted in the taxi delays.																	
18	1982	—	DEPARTURES SENT FROM 25R TO 24R	DUAL TAXIWAY	1982 (VFR)	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
11	1982	—	11	NEAR TERM	1982 (VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements resulted in reduced departure delays.																	
18	1982	—	—	DUAL TAXIWAY	1982 (VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
13	1982	—	—	BY-PASS TO RUNWAY 24R, HOLDING AREA ON TAXIWAY 75	1982 (VFR)	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742
RESULTS: The by-pass to runway 24R and the holding area on taxiway 75 resulted in reduced departure delays.																	

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→=REVISION A, 7/18/80

TABLE 31

SUMMARY OF ANNUAL DELAYS (ESTIMATES)

DEMAND	ATC SYSTEM SCENARIO	IMPROVEMENTS	ANNUAL DELAY (HOURS)	
1978	1978	none	37,991	
1982	1978	none	39,630	
1982 + 5%	1978	none	56,289	
1982 +15%	1978	none	130,137	
1982	1982	none	33,953	
1982	1978	1982	24,113	← was 33150
1982	1982	1982	21,036	
1987	1978	none	41,339	
1987	1978	1987	22,908	← was 21,188
1987	1987	none	24,354 ~~13,496~~ ~~21,728 (DATA FAILURE)~~	
1987	1987	1987	13,496	

← = REVISION A, 7/18/80

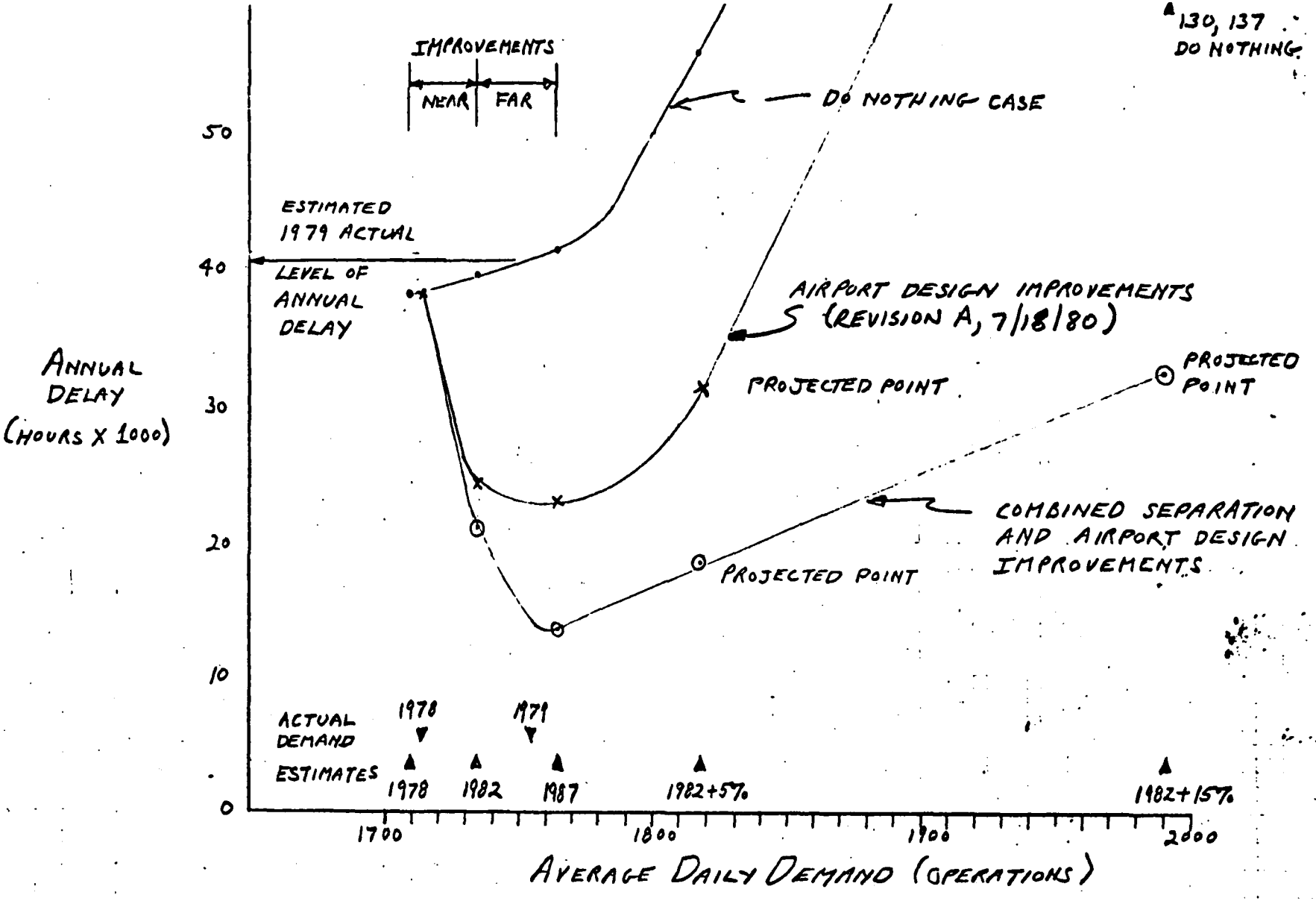

FIGURE 15 : SUMMARY OF ANNUAL DELAY ESTIMATES

REVISION A, 7/18/80

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DATE:

IN REPLY REFER TO:

NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER
ATLANTIC CITY, NEW JERSEY 08405

SUBJECT: Los Angeles Simulation Model Results

FROM: Program Manager, ACT-220

TO: Frank Jones, AWE-530

Enclosed is Data Package No. 10 for review by the Task Force members. Data package No. 9 was presented at the last meeting of the Task Force on April 29, 1980.

Attachment A contains the results of experiments #35, 36 and 37 requested by the Task Force to study delays after construction is completed on either runway 25R (VFR and IFR weather) or runway 25L (IFR weather).

Attachment B includes a comparison of the traffic counts for the first Friday in August of 1978 and 1979.

Attachment C includes comparisons and analyses of various experiments. The purpose of this attachment is to provide a narrative summary of those results for use by the Los Angeles Task Force in preparing their final report.

John R. Vanderveer

JOHN VANDERVEER

ATTACHMENT A

RESULTS OF EXPERIMENTS #35, #36 and #37

(TUNNEL CONSTRUCTION)

TABLE 1

SET 8 DEMAND

EXPERIMENT		RWY 24R	RWY 24L	RWY 25R	RWY 25L	TOTAL
22 (22A)	A	95	72	0	196	363
	D	29	162	0	235	426
	TOTAL	124	234	0	431	789
35	A	121	17	225	0	363
	D	25	117	284	0	426
	TOTAL	146	134	509	0	789
23	A	167	0	0	196	363
	D	0	191	0	235	426
	TOTAL	167	191	0	431	789
36	A	138	0	225	0	363
	D	0	142	284	0	426
	TOTAL	138	142	509	0	789
24	A	174	0	189	0	363
	D	0	185	241	0	426
	TOTAL	174	185	430	0	789
37	A	138	0	0	225	363
	D	0	142	0	284	426
	TOTAL	138	142	0	509	789
	A					
	D					
	TOTAL					

* MODIFIED DEMAND

LAX - STAGE 2

EXPERIMENT NO. 35

OBJECTIVE:

To access the impact on aircraft delay in 1982 under VFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS	DEPARTURE RUNWAYS
24L, 24R, 25R	24L, 24R, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #22 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 VFR1 separations were used. The 1982 demand was achieved by modifying the arrival demand for experiment #11 (moving 50 arrivals on the south complex to runway 24R) and changing all arrivals and departures on 25L to 25R.

TABLE 2

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 35

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	30	6	32	0	68
CLASS 2 (LARGE)	55	2	147	0	204
CLASS 3 (SMALL)	31	8	28	0	67
CLASS 4 (SMALLER)	5	1	18	0	24
TOTAL	121	17	225	0	363

	DEPARTURES				
CLASS 1 (HEAVY)	0	53	44	0	97
CLASS 2 (LARGE)	8	51	174	0	233
CLASS 3 (SMALL)	13	10	54	0	77
CLASS 4 (SMALLER)	4	3	12	0	19
TOTAL	25	117	284	0	426

ARRIVAL AND DEPARTURE TOTALS	146	134	509	0	789

TABLE 3

LAX EXP 35 DEMAND=82 SEP=78VFR1 CONFIG=A SCHED=X35 RTE=X1 25L CLOSED **25R TUNNEL COMPLETE**

AVERAGE FLOW RATES

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	AVERAGE TRAVEL TIMES FIX TO THRESH	THRESH TO GATE	GATE TO ROLL
700- 800	3.0	1.0	22.0	0.0	0.0	0.0	26.0	27.0	-1.0	2.3	13.0	25.7	0.0	0.0	0.0	41.0	48.0	-7.0	10.91	4.25	6.74
800- 900	19.0	1.0	25.0	0.0	0.0	0.0	45.0	44.0	1.0	14.3	13.8	28.2	0.0	0.0	0.0	56.3	64.0	-7.7	11.58	4.61	13.15
900-1000	7.0	1.0	31.8	0.0	0.0	0.0	39.8	40.0	-.2	16.2	22.4	21.3	0.0	0.0	0.0	59.9	54.0	5.9	13.37	3.93	15.89
1000-1100	19.9	3.0	30.9	0.0	0.0	0.0	53.8	55.0	-1.2	15.1	11.8	22.6	0.0	0.0	0.0	49.5	48.0	1.5	11.89	4.74	13.82
1100-1200	21.8	5.0	31.9	0.0	0.0	0.0	56.7	60.0	-3.3	6.3	16.0	26.8	0.0	0.0	0.0	49.1	52.0	-2.9	12.46	4.52	10.11
1200-1300	24.3	1.0	23.6	0.0	0.0	0.0	48.9	45.0	3.9	17.3	11.6	27.5	0.0	0.0	0.0	56.4	65.0	-8.6	14.19	4.89	17.88
1300-1400	9.1	2.0	27.7	0.0	0.0	0.0	38.8	39.0	-.2	18.0	21.1	20.9	0.0	0.0	0.0	60.0	54.0	6.0	10.67	4.80	21.99
1400-1500	16.9	5.0	31.8	0.0	0.0	0.0	53.7	53.0	.7	15.7	7.0	24.6	0.0	0.0	0.0	47.3	41.0	6.3	11.56	4.51	14.43
* 1500-1600	0.0	0.0	.3	0.0	0.0	0.0	.3	0.0	.3	1.7	.3	1.5	0.0	0.0	0.0	6.5	0.0	6.5	2.90	1.21	7.27

AVERAGE DELAYS

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI IN	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI OUT	RWY CNG	GRAND TOTAL AVERAGE DELAYS ARR DELAY	DEP DELAY
700- 800	0.0	0.0	2.2	0.0	0.0	0.0	1.9	0.0	.1	0.0	.2	2.3	0.0	0.0	0.0	1.5	0.0	.2	0.0	2.0	1.7
800- 900	.9	.4	2.6	0.0	0.0	0.0	1.9	.0	.2	7.7	2.8	7.3	0.0	0.0	0.0	6.3	0.0	1.1	.0	2.0	7.4
900-1000	.0	.0	4.8	0.0	0.0	0.0	3.8	.0	.1	8.6	6.4	8.2	0.0	0.0	0.0	7.5	0.0	2.4	.1	3.9	10.0
1000-1100	.9	.4	3.4	0.0	0.0	0.0	2.3	.1	.2	5.0	4.2	8.5	0.0	0.0	0.0	6.5	0.0	1.5	.0	2.5	8.0
1100-1200	.5	.8	4.1	0.0	0.0	0.0	2.5	.0	.1	4.7	1.8	5.2	0.0	0.0	0.0	4.1	0.0	.4	0.0	2.7	4.6
1200-1300	6.5	.0	3.8	0.0	0.0	0.0	5.1	.0	.4	17.4	5.3	6.9	0.0	0.0	0.0	9.7	0.0	2.2	.0	5.5	12.0
1300-1400	.4	0.0	2.2	0.0	0.0	0.0	1.7	.0	.3	18.2	8.9	7.2	0.0	0.0	0.0	11.0	0.0	4.7	.6	2.0	16.3
1400-1500	1.1	.2	2.7	0.0	0.0	0.0	2.0	.0	.0	9.4	1.4	6.1	0.0	0.0	0.0	6.5	0.0	1.8	.2	2.1	8.5
* 1500-1600	0.0	0.0	.4	0.0	0.0	0.0	.4	0.0	0.0	1.4	.5	1.3	0.0	0.0	0.0	1.5	0.0	.5	0.0	.4	2.0

*** clean-up hour**

LAX - STAGE 2

EXPERIMENT NO. 36

OBJECTIVE:

To access the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS	DEPARTURE RUNWAYS
24R, 25R	24L, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #23 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the arrivals on 25L were moved to 25R.

TABLE 4

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 36

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	36	0	32	0	68
CLASS 2 (LARGE)	57	0	147	0	204
CLASS 3 (SMALL)	39	0	28	0	67
CLASS 4 (SMALLER)	6	0	18	0	24
TOTAL	138	0	225	0	363

	DEPARTURES				
CLASS 1 (HEAVY)	0	53	44	0	97
CLASS 2 (LARGE)	0	59	174	0	233
CLASS 3 (SMALL)	0	23	54	0	77
CLASS 4 (SMALLER)	0	7	12	0	19
TOTAL	0	142	284	0	426

ARRIVAL AND DEPARTURE TOTALS	138	142	509	0	789

TABLE 5

LAX EXP 36 DEMAND=82 SEP=78IFR1 CONFIG=A SCHED=X36 RTE=X1 25L CLOSED **25R TUNNEL COMPLETE**

AVERAGE FLOW RATES

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	AVERAGE TRAVEL TIMES FIX TO THRESH	THRESH TO GATE	GATE TO ROLL
700- 800	4.0	0.0	21.9	0.0	0.0	0.0	25.9	27.0	-1.1	0.0	18.6	20.7	0.0	0.0	0.0	39.3	48.0	-8.7	12.65	4.28	8.39
800- 900	20.0	0.0	24.5	0.0	0.0	0.0	44.5	44.0	.5	0.0	27.0	18.4	0.0	0.0	0.0	45.4	64.0	-18.6	13.65	4.69	20.29
900-1000	6.0	0.0	25.1	0.0	0.0	0.0	33.1	40.0	-6.9	0.0	36.0	19.1	0.0	0.0	0.0	55.1	55.0	.1	18.28	4.08	26.50
1000-1100	19.0	0.0	26.2	0.0	0.0	0.0	45.2	55.0	-9.8	0.0	34.4	16.2	0.0	0.0	0.0	50.6	48.0	2.6	22.67	4.74	37.03
1100-1200	21.5	0.0	26.0	0.0	0.0	0.0	47.5	60.0	-12.5	0.0	34.0	17.3	0.0	0.0	0.0	51.3	52.0	-.7	31.67	4.82	33.86
1200-1300	21.0	0.0	22.1	0.0	0.0	0.0	43.1	45.0	-1.9	0.0	28.9	18.3	0.0	0.0	0.0	47.2	65.0	-17.8	44.47	4.74	26.10
1300-1400	19.6	0.0	23.9	0.0	0.0	0.0	43.5	39.0	4.5	0.0	28.9	16.7	0.0	0.0	0.0	45.6	54.0	-8.4	42.67	4.79	33.60
1400-1500	19.3	0.0	23.3	0.0	0.0	0.0	42.6	53.0	-10.4	0.0	28.7	16.7	0.0	0.0	0.0	45.4	41.0	4.4	34.68	5.08	42.77
*1500-1600	.9	0.0	22.4	0.0	0.0	0.0	23.3	0.0	23.3	0.0	25.8	8.0	0.0	0.0	0.0	33.8	0.0	33.8	81.78	4.13	48.43

AVERAGE DELAYS

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI IN	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI OUT	RWY CNG	GRAND TOTAL AVERAGE DELAYS ARR DELAY	DEP DELAY
700- 800	0.0	0.0	4.3	0.0	0.0	0.0	3.6	.0	.1	0.0	.6	5.0	0.0	0.0	0.0	2.9	0.0	.3	0.0	3.8	3.1
800- 900	3.0	0.0	4.7	0.0	0.0	0.0	3.9	.0	.2	0.0	12.3	11.7	0.0	0.0	0.0	12.0	0.0	.7	1.4	4.2	14.1
900-1000	.0	0.0	11.3	0.0	0.0	0.0	8.6	.0	.2	0.0	15.6	10.7	0.0	0.0	0.0	13.9	0.0	.9	6.0	8.8	20.8
1000-1100	3.1	0.0	19.9	0.0	0.0	0.0	12.8	.1	.2	0.0	18.4	15.5	0.0	0.0	0.0	17.5	0.0	1.6	12.0	13.1	31.1
1100-1200	14.8	0.0	28.2	0.0	0.0	0.0	22.1	.0	.3	0.0	15.9	12.7	0.0	0.0	0.0	14.7	0.0	1.3	11.9	22.5	28.0
1200-1300	23.6	0.0	46.2	0.0	0.0	0.0	34.7	.0	.4	0.0	18.3	12.3	0.0	0.0	0.0	15.9	0.0	.7	3.5	35.1	20.1
1300-1400	21.4	0.0	44.0	0.0	0.0	0.0	33.7	.0	.2	0.0	20.0	10.9	0.0	0.0	0.0	16.6	0.0	.6	10.9	33.9	28.1
1400-1500	4.1	0.0	43.1	0.0	0.0	0.0	25.6	.0	.3	0.0	18.6	10.7	0.0	0.0	0.0	15.7	0.0	.8	20.6	26.0	37.1
*1500-1600	5.9	0.0	54.0	0.0	0.0	0.0	52.3	.0	.0	0.0	13.0	7.6	0.0	0.0	0.0	12.2	0.0	1.6	27.2	52.3	41.1

*** clean-up hour**

LAX - STAGE 2

EXPERIMENT NO. 37

OBJECTIVE:

To access the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25R during construction of the Sepulveda Tunnel. Tunnel construction on 25L was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS	DEPARTURE RUNWAYS
24R, 25L	24L, 25L

RELATED COMPARISON EXPERIMENTS:

Experiment #24 with tunnel construction on 25L and no improvement on 25R.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the departures on 25R were moved to 25L.

TABLE 6

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 37

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	36	0	0	32	68
CLASS 2 (LARGE)	57	0	0	147	204
CLASS 3 (SMALL)	39	0	0	28	67
CLASS 4 (SMALLER)	6	0	0	18	24
TOTAL	138	0	0	225	363
	DEPARTURES				
CLASS 1 (HEAVY)	0	53	0	44	97
CLASS 2 (LARGE)	0	59	0	174	233
CLASS 3 (SMALL)	0	23	0	54	97
CLASS 4 (SMALLER)	0	7	0	12	19
TOTAL	0	142	0	284	426
ARRIVAL AND DEPARTURE TOTALS	138	142	0	509	789

TABLE 7

LAX EXP 37 DEMAND=82 SEP=78IFR1 CONFIG=A SCHED=X37 RTE=X1 25R CLOSED **25L TUNNEL COMPLETE**

AVERAGE FLOW RATES

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	DE-MAND	DIF	AVERAGE TRAVEL TIMES FIX TO THRESH	THRESH TO GATE	GATE TO ROLL
700- 800	4.0	0.0	0.0	21.9	0.0	0.0	25.9	27.0	-1.1	0.0	19.0	0.0	20.7	0.0	0.0	39.7	48.0	-8.3	12.14	4.50	7.90
800- 900	20.0	0.0	0.0	24.5	0.0	0.0	44.5	44.0	.5	0.0	25.0	0.0	19.2	0.0	0.0	44.2	64.0	-19.8	13.60	5.00	20.00
900-1000	8.0	0.0	0.0	25.1	0.0	0.0	33.1	40.0	-6.9	0.0	37.3	0.0	18.9	0.0	0.0	56.2	55.0	1.2	18.29	4.51	26.75
1000-1100	19.0	0.0	0.0	26.8	0.0	0.0	45.8	55.0	-9.2	0.0	34.2	0.0	15.5	0.0	0.0	49.7	48.0	1.7	22.64	4.98	36.41
1100-1200	21.6	0.0	0.0	26.7	0.0	0.0	48.3	60.0	-11.7	0.0	32.7	0.0	19.3	0.0	0.0	52.0	52.0	0.0	31.98	5.14	33.60
1200-1300	22.3	0.0	0.0	25.3	0.0	0.0	47.6	45.0	2.6	0.0	31.1	0.0	18.7	0.0	0.0	49.8	65.0	-15.2	44.21	4.96	28.84
1300-1400	21.1	0.0	0.0	26.2	0.0	0.0	47.3	39.0	8.3	0.0	30.9	0.0	16.7	0.0	0.0	47.6	54.0	-6.4	41.49	5.05	37.51
1400-1500	20.9	0.0	0.0	25.1	0.0	0.0	46.0	53.0	-7.0	0.0	29.9	0.0	17.9	0.0	0.0	47.8	41.0	6.8	33.59	5.58	45.69
* 1500-1600	1.1	0.0	0.0	23.4	0.0	0.0	24.5	0.0	24.5	0.0	30.9	0.0	8.9	0.0	0.0	39.8	0.0	39.8	58.52	4.58	58.51

AVERAGE DELAYS

TIME	ARRIVALS RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI IN	DEPARTURES RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	RWY	TOT	RWY CRS	TAXI OUT	RWY CNG	GRAND TOTAL AVERAGE DELAYS ARR DELAY	DEP DELAY
700- 800	0.0	0.0	0.0	4.2	0.0	0.0	3.6	.0	.1	0.0	.6	0.0	3.8	0.0	0.0	2.2	.0	.3	0.0	3.7	2.5
800- 900	3.2	0.0	0.0	4.7	0.0	0.0	4.0	.1	.2	0.0	12.8	0.0	11.3	0.0	0.0	12.0	.0	.7	1.0	4.3	13.7
900-1000	.0	0.0	0.0	11.5	0.0	0.0	8.7	.0	.2	0.0	15.4	0.0	11.2	0.0	0.0	14.0	.0	.8	6.2	8.9	21.0
1000-1100	3.2	0.0	0.0	19.5	0.0	0.0	12.8	.1	.1	0.0	17.8	0.0	15.2	0.0	0.0	17.0	.0	1.3	12.0	12.9	30.3
1100-1200	15.2	0.0	0.0	27.8	0.0	0.0	22.2	.0	.4	0.0	16.3	0.0	11.2	0.0	0.0	14.3	.0	1.2	12.1	22.6	27.6
1200-1300	24.0	0.0	0.0	44.5	0.0	0.0	34.9	.0	.3	0.0	19.3	0.0	11.7	0.0	0.0	16.3	.0	.8	5.4	35.3	22.6
1300-1400	22.2	0.0	0.0	40.8	0.0	0.0	32.5	.0	.3	0.0	21.0	0.0	14.0	0.0	0.0	18.2	.0	.7	12.6	32.8	31.6
1400-1500	4.6	0.0	0.0	40.9	0.0	0.0	24.4	.0	.5	0.0	21.5	0.0	10.4	0.0	0.0	17.3	.0	.8	21.5	25.0	39.7
* 1500-1600	6.8	0.0	0.0	51.6	0.0	0.0	49.6	.0	.0	0.0	16.2	0.0	7.2	0.0	0.0	14.2	.1	1.9	36.2	49.6	52.4

*** clean-up hour**

ATTACHMENT B

COMPARISON OF TRAFFIC COUNTS AND DEMAND

The traffic counts and projected demands over a 24-hour period are shown in Table 1. In addition, the 1978 and 1979 OAG schedules for the first Friday in August were obtained to determine the changes in scheduled activity.

In 1979, airlines who scheduled OAG flights in 1978 increased their activity by 3.3%. There were 1323 scheduled flights in the 1978 OAG and 1366 scheduled by the same airlines in the 1979 OAG.

The actual activity level for 1979 showed an increase of 2.2% for the 24-hour traffic count over the same period of time in 1978 (1717 aircraft in 1978 and 1755 aircraft in 1979). The projected 1982 demand represents a 1.5% increase over the 1978 24-hour base demand (1735 aircraft in 1982 and 1710 aircraft in 1978). The 1982 demand was increased by 5% and 15% resulting in an increase of 6.3% and 16.4% over the 1978 24-hour base demand. The 1987 demand represents 3.2% increase over the 1978 24-hour base demand (1764 aircraft in 1987 and 1710 aircraft in 1978).

The 1982 demand for the 24-hour period is 1.2% less than the actual 1979 traffic count (1735 aircraft in 1982 and 1755 aircraft in 1979). The actual 1979 traffic count is less than the 1982 +5% level of activity and the projected 1987 demand. The fleet mix percentages for the 1979 OAG schedule and the projected 1982 OAG schedule are as follows:

	1979	1982
Heavy-Class 1	24.7%	28.9%
Large-Class 2	56.5%	59.4%
Small-Class 3	16.4%	11.7%
Smaller-Class 4	2.4%	0.0%

Comparisons indicated that the 1979 demand on the Los Angeles International Airport increased to a level slightly above the projected 1982 demand, but the projected 1982 conversion of the fleet to the larger aircraft has not occurred in the 1979 demand.

TABLE 1

TRAFFIC COUNT FOR FIRST FRIDAY IN AUGUST

TIME	1978 TRAFFIC COUNT	1978 DEMAND	1979 TRAFFIC COUNT	1982 DEMAND	1982 DEMAND +5%	1982 DEMAND +15%	1987 DEMAND
0000	37	43	43	45	47	52	43
0100	42	37	42	41	43	47	43
0200	24	23	20	23	24	26	23
0300	11	9	8	8	8	10	11
0400	8	17	14	16	16	18	16
0500	14	17	15	19	19	23	18
0600	34	33	32	34	36	40	34
0700	69	77	83	73	76	84	77
0800	105	103	88	109	114	125	113
0900	87	92	106	95	100	108	92
1000	101	98	114	101	106	116	103
1100	118	111	114	114	120	131	114
1200	106	110	107	109	114	124	115
1300	98	93	93	94	99	108	95
1400	88	86	96	94	98	107	92
1500	79	86	80	79	83	91	85
1600	108	96	98	105	110	120	98
1700	76	88	94	83	88	96	94
1800	97	95	103	95	99	109	95
1900	108	108	101	111	116	127	108
2000	91	78	83	80	84	91	85
2100	83	83	79	80	84	92	80
2200	80	69	78	69	73	79	67
2300	53	58	64	58	61	67	63
TOTAL	1717	1710	1755	1735	1818	1991	1764
	ACTUAL	BASE	2.2% Increase Over 1978 Actual Traffic Count	1.5% Increase over 1978 Base Demand	6.3% Increase Over 1978 Base Demand	16.4% Increase Over 1978 Base Demand	3.2% Increase Over 1978 Base Demand

ATTACHMENT C

NARRATIVE SUMMARY OF RESULTS

(INFORMATION FOR THE TASK FORCE FOR PREPARATION OF FINAL REPORT)

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1. INTRODUCTION

1.1. General.

Airfield operations at the Los Angeles International Airport are expected to increase in the immediate future. A study of the effects of this increase in air traffic demand and proposed improvements at the airport (procedures, hardware, and airport design) was initiated in June 1975. The results of the initial capacity study appeared in an Interim Report (September 1977) issued by the Los Angeles International Airport Improvement Program Task Force. The present delay study was based upon the report and a technical plan prepared in September 1978, along with a Federal Aviation Administration report (FAA-EM-78-8A) entitled "Parameters of Future ATC Systems Relating to Airport Capacity/Delay" (June 1978).

1.2. Objective. The purpose of this effort was:

1. To identify the causes of delay and determine the effect of various airport design improvements on delay at the airport.
2. To identify the delay reduction benefits of alternative procedures and the hardware improvement options for immediate, short term and long term implementation.
3. To determine the relationships between air traffic demand and delay in the present and future time periods as an aid to establishing acceptable air traffic movement levels.
4. To obtain new insight into the interdependence of terminal facilities, airport design, procedures, fleet mix and air traffic demand.

1.3. Background.

The airport delay study began with a description of the present day air traffic control procedures at the Los Angeles International Airport. A report was prepared in July 1978 (FAA-NA-96-156-1) which revised and updated the ground/airborne scenarios. The next step was the preparation of a technical plan which included a list of the experiments to be performed and information regarding the application of the airfield simulation model. Various steps and milestones were planned along with a description of data requirements for the computer (model) runs.

The effort was accomplished by the Airport Improvement Task Force reviewing a series of data packages containing information on the preparation of the model runs, revisions to the experimental design (suggested by the Task Force) and the results of the experiments. The data packages contained infomation on the calibration of the model based on field data, description of the model inputs for the experiments, air traffic demand forecasts (including runway and aircraft class distributions), results of experiments and preliminary analysis of those results.

Comments on each of the data packages by the Task Force were incorporated into subsequent work performed on the program.

2. DISCUSSION.

2.1. Air Traffic Control Procedures.

The air traffic control service at the Los Angeles International Airport is extended to each airline company, general aviation, the military, the airport authority, the local and regional residents, and the general public. The ATC procedures employed at the airport are responsive to a variety of geographic and airfield conditions. The desired result is a safe level of service which holds delays to minimum throughout the day by applying present day air traffic control rules and regulations.

Some specific service conditions reflected in the ATC procedures are:

1. The assignment, when possible, of arrivals to runways closest to their gate areas.
2. The assignment of departures to runways based on the route of flight (with the exception of heavy aircraft which must use the north complex).
3. Restricted use of departure runway 24R as a noise abatement procedure.
4. Over ocean nighttime operations.
5. Greater utilization of south complex.

The ATC procedures are considered in the study in two ways. The separations maintained between arrivals and departures are used as model inputs for the computer run. The present day conditions at the airfield are reflected in the gate and runway distributions used for experiments with VFR conditions and no airport design improvements.

2.2. Experimental Design and Model Application.

The experimental design for this effort was developed early in the program and is shown in Table 1. The experiments were divided into two stages to permit a review of some initial results and changes in the remaining experiments to take advantage of any redirection of effort indicated by those findings. The three main areas of the experiments which had to be translated into model inputs were the air traffic control scenario, the airport design improvements and the air traffic demand.

2.2.1. Air Traffic Control Scenarios.

The time frame for the air traffic control scenario indicated the aircraft separation values to be used for the experiment for either VFR or IFR weather conditions. Present day VFR separation values were established by calibrating the model (i.e., matching model output to field data collected at the facility). The base values for arrival-to-arrival and departure-to-departure separations were obtained from the FAA report on "Parameter of Future ATC Systems Relating to Airport Capacity/Delay" (FAA-EM-78-8A). The remaining values for separations followed the results obtained through calibration. Specific nighttime separations had to be developed from information provided by the facility. The referenced separations did not apply to a runway dependency with arrivals opposing the flow of the departures.

2.2.2. Airport Design Improvements.

The airport design improvements were initially identified in the Los Angeles International Airport Improvement Task Force Interim Report. The near term improvements were noted in Table 1, Los Angeles Delay Experiments.

The near term improvements included:

1. High-speed taxiway off runway 25L to the south (Improvement #2).
2. Strengthening of the Sepulveda Tunnel (Improvement #3).
3. New taxiway access to the threshold of runway 24R.
4. Temporary holding areas for future taxiway 75.
5. Parking for 20 aircraft at the west end of the airport.
6. Terminal Expansion including Satellite 1 and the International Terminal.
7. High-speed taxi exit off runway 7L (Improvement #5).
8. High-speed exit off runway 6R to taxiway 47 (Improvement #7).
9. Departure by-pass around 7L to 7R (Improvement #8).
10. Opening runway 25 for small aircraft arrivals and departures during tunnel construction.

Various near term improvements were introduced into different experiments to determine their effectiveness in reducing delays and process ing the air traffic demand. The improvements were introduced into the experiments by changing the model inputs and the runway demand distributions.

The changes in the model inputs can be illustrated by comparing a link-node diagram of the airport used to develop model inputs for the present day setup, Figure 1, with the diagram showing the noted improvements, Figure 2. Some of the improvements necessitated changes in the distribution of the air traffic demand to the runways and gates. For example, strengthening of the Sepulveda Tunnel permitted heavy departures from the south complex and generated a greater demand on runways 25R and 25L because of their proximity to the gate areas 4, 5, 6, 7 and 8.

TABLE 1

LOS ANGELES DELAY EXPERIMENTS

Experiment number	Model	Study case[a]	Arrival runways	Departure runways	Weather	Demand	ATC System scenario[b]	Near Tearm improvements[c]
Stage 1 Experiments								
1	ASM[d]	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1978	1978	None
2	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1978	1978	None
3	ASM	3	24R, 25L	24L, 25R	IFR2	1978	1978	None
4	ASM	5	6R, 7L	24L, 25R	VFR1	1978	1978	None
5	ASM	6	6R, 7L	24L, 25R	IFR1	1978	1978	None
6	ASM	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1978	1978	None
7 (7A) (7B)	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982 (+5%) (+15%)	1978	None
8 (8A) (8B)	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1982 (+5%) (+15%)	1978	None
9	ASM	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1982	1978	None
10	ASM	5	6R, 7L	24L, 25R	VFR1	1982	1978	None
10A	ASM	6	6R, 7L	24L, 25R	IFR1	1982	1978	None
11	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	1982[e]
12	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1982	1982	1982
13	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	2, 3[f]
15	ASM	5	6R, 7L	24L, 25R	VFR1	1982	1982	5, 7[g]
16	ASM[h]	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1982	1982	5, 7, 8[g]
17	ADM	n.a.	n.a.	n.a.	n.a.	1978	1978	None
17A	RCM[i]	7	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1982	Tunnel Construction[j]
17B	RCM	7	24L, 24R, 25L, 25x[k]	24L, 24R, 25L, 25X	VFR1	1982	1982	Tunnel Construction
17C	RCM	7	24L, 24R, 25L, 26	24L, 24R, 25L, 26	VFR1	1982	1982	Comments-Usage for Light

n.a. = not applicable.

a. Study cases (combinations of runway use and weather conditions) are defined in Figure III-1.

b. FAA will describe impact of 1982 and post-1987 ATC systems on model inputs.

c. Potential near-term improvements are identified in the Los Angeles International Airport Improvement Task Force Interim Report, and in Appendix B.

d. Airfield Simulation Model.

e. Task Force establishes packages of near-term improvements most likely to be implemented in 1982 and 1987 time frames. The 1982 package includes improvement # 2 (high-speed taxiway off Runway 25L to the south), improvement # 3 (strengthening of the Sepulveda Tunnel), (cont.)

TABLE 1 (CONTINUED)

LOS ANGELES DELAY EXPERIMENTS

e. (cont.) new taxiway access to threshold of Runway 24R, and temporary holding areas on future Taxiway 75. The 1987 package includes all 1982 improvements plus Satellite 1, International Terminal, and/or remote parking for 20 aircraft at west end of airport. These packages of improvements are subject to Task Force review and revision.

f. Impact of absence of Improvements # 2 and #3 (high-speed taxiway of Runway 25L and strengthening of the Sepulveda Tunnel).

g. Improvement # 5 is a high-speed taxi exit off Runway 7. Improvement # 7 is a high-spped taxi exit to Taxiway 47 from Runway 6R. Improvement #8 is a bypass area on the north side of Runway 7L.

h. Annual Delay Model.

i. Runway Capacity Model.

j. Runway 25R closed for tunnel construction.

k. During closure of 25R for tunnel construction, parts of Runway 25 are open for small aircraft arrivals and departures.

TABLE 1 (CONTINUED)

LOS ANGELES DELAY EXPERIMENTS

Experiment number	Model	Study case[a]	Arrival Runways	Departure Runways	Weather	Demand	ATC System scenario[b]	Near-term improvements[c]
Stage 2 Experiments								
18	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	10[l]
19 A	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1978	Terminal Expansion[n]
20	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	Terminal Expansion[n]
21	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	Remote Terminal [o]
22	ASM	7	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1978	Tunnel Construction
22A	ASM	8	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1978	Dual Taxiway[p]
23	ASM	8	24R, 25L	24L, 25L	IFR1	1982	1978	Tunnel Construction 25R
24	ASM	9	24R, 25R	24L, 25R	IFR1	1982	1978	Tunnel Construction 25L
25	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1987	1987	1987[e]
25A	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1987	1987	1987
26	ASM	2	24L, 24R, 25L, 25R	24L, 24R	IFR1	1987	1987	1987
27	ADM	n.a.	n.a.	n.a.	n.a.	1982	1982	1982
28	ADM	n.a.	n.a.	n.a.	n.a.	1982	1982	None
29	ADM	n.a.	n.a.	n.a.	n.a.	1982	1978	1982
30	ADM	n.a.	n.a.	n.a.	n.a.	1982	1978	None
31	ADM	n.a.	n.a.	n.a.	n.a.	1987	1987	1987
32	ADM	n.a.	n.a.	n.a.	n.a.	1987	1987	None
33	ADM	n.a.	n.a.	n.a.	n.a.	1987	1978	1987
34	ADM	n.a.	n.a.	n.a.	n.a.	1987	1978	None
35	ASM	n.a.	24L, 24R, 25R	24L, 24R, 25R	VFR1	1982	1978	Tunnel Construction 25L, 25R Done
36	ASM	n.a.	24R, 25R	24L, 25R	IFR1	1982	1978	Tunnel Construction 25L, 25R Done
37	ASM	n.a.	24R, 25L	24L, 25L	IFR1	1982	1978	Tunnel Construction 25R, 25L Done

l. Improvement #10 consists of a series of taxiway improvements identified in Appendix B.

n. Construction of Satellite 1 and International Terminal. The need for this experiment will be reviewed by the Task Force after consideration of future airline terminal locations.

o. Remote parking for 20 aircraft at west end of Airport.

p. Additional experiment may be needed to test value of dual taxiway system around Satellite 4 during tunnel construction

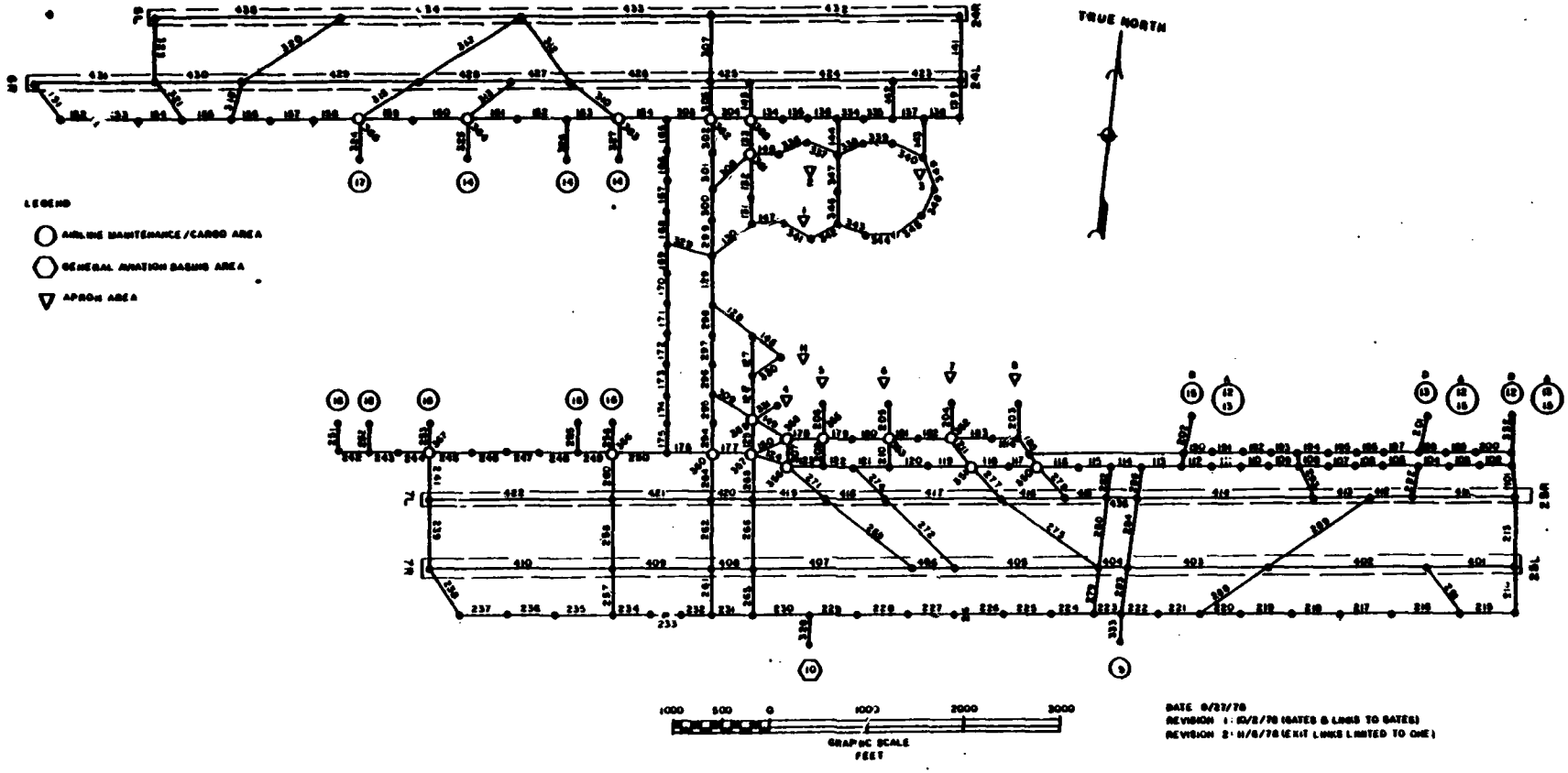

FIGURE 1 LAX LINK NODE DIAGRAM (PRESENT)

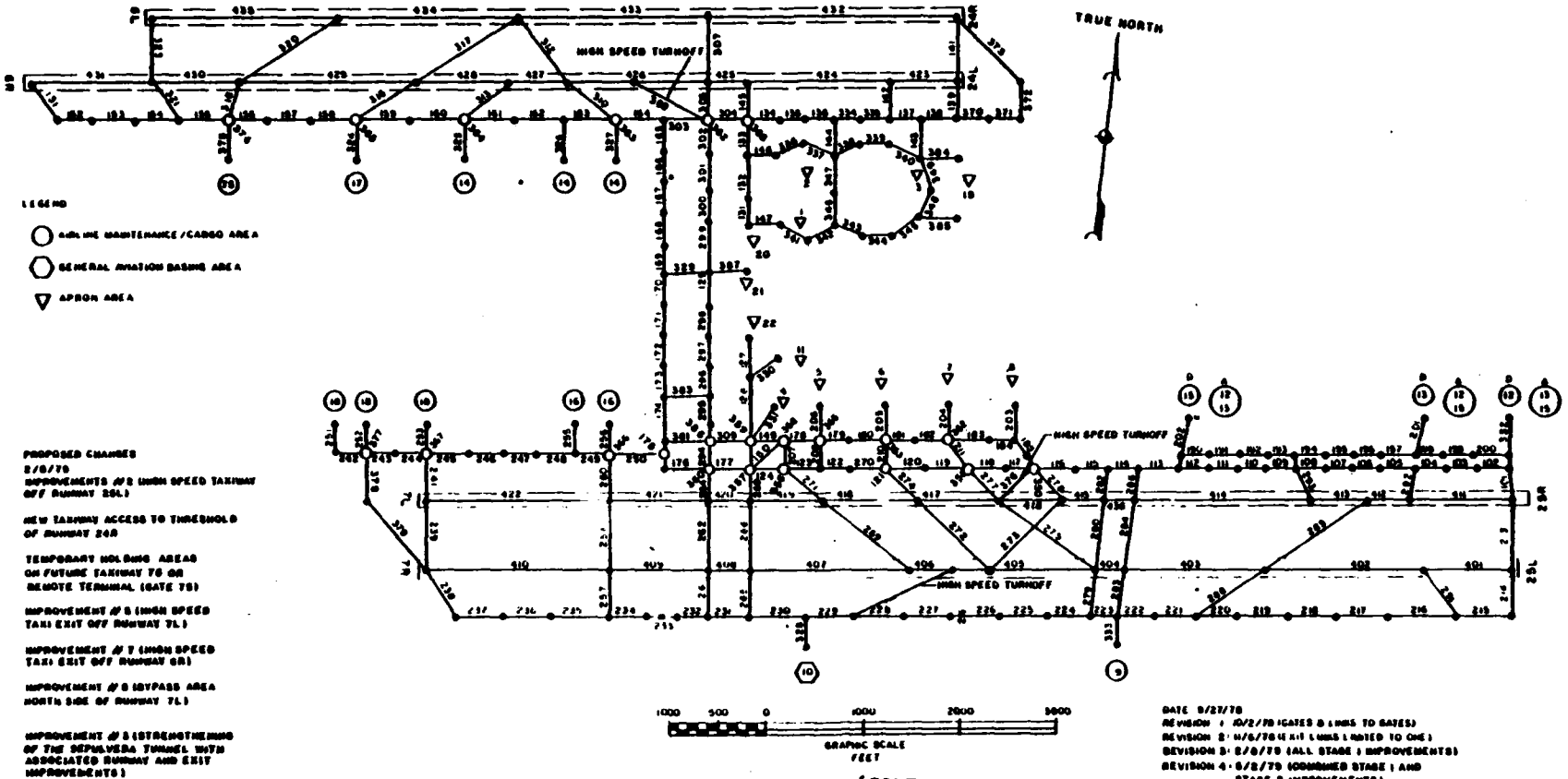

FIGURE 2 : LAX LINK NODE DIAGRAM (COMBINED IMPROVEMENTS)

2.2.3. Air Traffic Demand.

Actual and forecasted air traffic demands were prepared for the 1978, 1982 and 1987 time periods. Additional 1982 aircraft schedules were prepared in total daily increases of 5% and 15% over the projected 1982 operations. Another air traffic demand schedule was constructed for the 1987 time period which added a 10% increase in arrivals and departures during peak hours. The hourly air traffic demands are shown in Tables 2 through 7.

Each air traffic demand applied to an experiment required a specified arrival and departure runway distribution and individual gate assignments by airline.

The basis for the initial VFR distribution of traffic was the field data collected at the airport during the week of September 24, 1978. Data reduction programs calculated the actual distribution of traffic over the runways and gates.

When the experiment required another weather condition or an improvement in airport design, the aircraft schedule was changed to reflect the proper weather condition or the revised airport operation. After the computer simulation of a particular experiment, the delay and travel time summaries were analyzed to determine whether the results represented logical operating conditions for the airport. If necessary, the demand was modified to produce a reasonable distribution of traffic on the runways by reassigning arrivals from the south complex to the north complex of the airport. This was done by changing the runway assignments in the schedule and/or dynamically reassigning runways during the model run.

As an example, the original demand for experiment #2 was modified by reassigning arrivals and is referred to as demand schedule #2M. For experiment #11 (rerouted), the original demand schedule for experiment #11 wad dynamically modified by changing one of the model's input parameters. When delays for departures on runway 25R began to build to a high level, departures assigned to runway 25R on the south complex were rerouted to runway 24R on the north complex.

Changes in the demand, whether by schedule changes and/or dynamic rerouting, produced lower delay values and better traffic flow over the entire airport.

The actual (1978) and projected (1982, etc.) demand schedules were used to calculate the estimated annual demand and passenger enplanements for the Los Angeles International Airport. The basic assumption in the calcualtion was that the demand represented an average day over a 2 month period, July and August, which comprised about 19% of the total traffic and 25% of the passenger enplanements. The calculations are shown in Table 8.

TABLE 2

1978 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	16	0	1	2	19
0100	10	7	0	1	18
0200	6	7	1	0	14
0300	1	3	1	0	5
0400	5	5	0	0	10
0500	4	2	1	0	7
0600	9	0	3	4	16
0700	16	1	7	5	29
0800	23	4	5	7	39
0900	25	2	4	9	40
1000	35	1	6	8	50
1100	41	4	6	8	59
1200	31	1	4	9	45
1300	29	0	3	10	42
1400	29	4	4	10	47
1500	26	1	5	11	43
1600 to 2400	269	10	32	52	363
TOTALS	575	52	83	136	846
	DEPARTURES				
0000	19	1	2	2	24
0100	9	10	0	0	19
0200	1	7	1	0	9
0300	1	2	1	0	4
0400	1	5	1	0	7
0500	4	5	0	1	10
0600	9	2	4	2	17
0700	32	4	6	6	48
0800	49	3	3	9	64
0900	38	4	5	5	52
1000	34	2	6	6	48
1100	34	3	4	11	52
1200	44	5	5	11	65
1300	39	1	1	10	51
1400	20	0	7	12	39
1500	30	0	6	7	43
1600 to 2400	214	22	32	44	312
TOTALS	578	76	84	126	864

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
21.5 %	55.4 %	17.9 %	5.2 %

TABLE 3

1982 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	12	4	1	2	19
0100	14	7	0	1	22
0200	4	7	2	0	13
0300	3	1	0	0	4
0400	4	5	0	0	9
0500	5	3	1	0	9
0600	6	0	6	4	16
0700	17	1	2	5	25
0800	27	4	7	7	45
0900	26	2	4	9	41
1000	38	2	5	8	53
1100	43	4	7	8	62
1200	30	1	4	9	44
1300	28	0	2	10	40
1400	35	4	4	10	53
1500	19	1	5	11	36
1600 to 2400	271	12	33	52	368
TOTALS	582	58	83	136	859
	DEPARTURES				
0000	22	0	2	2	26
0100	8	11	0	0	19
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	2	4	2	18
0700	30	6	6	6	48
0800	49	3	3	9	64
0900	42	2	5	5	54
1000	34	2	6	6	48
1100	34	3	4	11	52
1200	42	7	5	11	65
1300	43	0	1	10	54
1400	22	0	7	12	41
1500	30	0	6	7	43
1600 to 2400	213	24	32	44	313
TOTALS	591	75	84	126	876

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
23.9 %	55.0 %	15.9 %	5.2 %

TABLE 4

1982 + 5% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	12	5	1	2	20
0100	14	8	0	1	23
0200	4	8	2	0	14
0300	3	1	0	0	4
0400	4	5	0	0	9
0500	5	3	1	0	9
0600	6	1	6	4	17
0700	17	2	2	5	26
0800	27	6	7	7	47
0900	26	4	4	9	43
1000	38	5	5	8	56
1100	43	7	7	8	65
1200	30	3	4	9	46
1300	28	2	2	10	42
1400	35	6	4	10	55
1500	19	3	5	11	38
1600 to 2400	271	30	33	52	386
TOTALS	582	99	83	136	900
	DEPARTURES				
0000	22	1	2	2	27
0100	8	12	0	0	20
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	3	4	2	19
0700	30	8	6	6	50
0800	44	6	3	9	67
0900	42	5	5	5	57
1000	34	4	6	6	50
1100	34	6	4	11	55
1200	42	10	5	11	68
1300	43	3	1	10	57
1400	22	2	7	12	43
1500	30	2	6	7	45
1600 to 2400	213	40	32	44	329
TOTALS	591	117	84	126	918

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
23.9 %	55.3 %	15.9 %	4.9 %

TABLE 5

1982 + 15% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	12	7	1	2	22
0100	14	10	0	1	25
0200	4	9	2	0	15
0300	3	2	0	0	5
0400	4	6	0	0	10
0500	5	5	1	0	11
0600	6	3	6	4	19
0700	17	5	2	5	29
0800	27	10	7	7	51
0900	26	7	4	9	46
1000	38	10	5	8	61
1100	43	13	7	8	71
1200	30	7	4	9	50
1300	28	6	2	10	46
1400	35	11	4	10	60
1500	19	7	5	11	42
1600 to 2400	271	67	33	52	423
TOTALS	582	185	83	136	986
	DEPARTURES				
0000	22	4	2	2	30
0100	8	14	0	0	22
0200	4	6	1	0	11
0300	0	4	1	0	5
0400	4	3	1	0	8
0500	4	7	0	1	12
0600	10	5	4	2	21
0700	30	13	6	6	55
0800	49	13	3	9	74
0900	42	10	5	5	62
1000	34	9	6	6	55
1100	34	11	4	11	60
1200	42	16	5	11	74
1300	43	8	1	10	82
1400	22	6	7	12	47
1500	30	6	6	7	49
1600 to 2400	213	69	32	44	358
TOTALS	591	204	84	126	1005

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
23.9 %	55.6 %	15.9 %	4.6 %

TABLE 6

1987 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	11	4	0	2	17
0100	13	8	1	1	23
0200	5	7	1	0	13
0300	5	1	1	0	7
0400	4	5	0	0	9
0500	4	3	1	0	8
0600	7	0	5	4	16
0700	18	1	5	5	29
0800	31	3	7	7	48
0900	23	3	2	9	37
1000	37	3	6	8	54
1100	44	4	6	8	62
1200	32	3	5	9	49
1300	28	0	2	10	40
1400	32	4	4	10	50
1500	27	0	4	11	42
1600 to 2400	277	13	33	52	375
TOTALS	598	62	83	136	879
	DEPARTURES				
0000	22	0	2	2	26
0100	8	12	0	0	20
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	2	4	2	18
0700	30	6	6	6	48
0800	50	3	3	9	65
0900	43	2	5	5	55
1000	35	2	6	6	49
1100	35	2	4	11	52
1200	43	7	5	11	66
1300	44	0	1	10	55
1400	23	0	7	12	42
1500	30	0	6	7	43
1600 to 2400	215	24	32	44	315
TOTALS	600	75	84	126	885

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
27.0 %	54.0 %	13.9 %	5.1 %

TABLE 7

1987 DEMAND WITH PEAKS

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	ARRIVALS				
0000	11	4	0	2	17
0100	13	8	1	1	23
0200	5	7	1	0	13
0300	5	1	1	0	7
0400	4	5	0	0	9
0500	4	3	1	0	8
0600	7	6	5	4	16
0700	18	1	5	5	29
0800	31	8	7	7	53
0900	23	3	2	9	37
1000	37	3	6	8	59
1100	44	10	6	8	68
1200	32	3	5	9	49
1300	28	0	2	10	40
1400	32	4	4	10	50
1500	27	0	4	11	42
1600 to 2400	277	13	35	52	375
TOTALS	598	73	83	136	890
	DEPARTURES				
0000	22	0	2	2	26
0100	8	12	0	0	20
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	2	4	2	18
0700	30	6	6	6	48
0800	50	8	3	9	70
0900	43	2	5	5	55
1000	35	2	6	6	49
1100	35	2	4	11	52
1200	43	14	5	11	73
1300	44	0	1	10	55
1400	23	0	7	12	42
1500	30	0	6	7	43
1600 to 2400	215	24	32	44	315
TOTALS	600	87	84	126	897

CLASS DISTRIBUTION (0000 to 2400)

Class 1	Class 2	Class 3	Class 4
27.0 %	54.2 %	13.8 %	5.0 %

TABLE 8

ANALYSIS of YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
Total Daily Air Carrier and Air Taxi Operations	1448	1473	1556	1729	1502
Total Departures (avg.)	724	737	778	865	751
% of Class 1	22.7	25.2	25.2	25.1	28.5
Class 2	58.4	58.0	58.1	58.2	56.9
Class 3	18.9	16.8	16.7	16.7	14.6
# of Seats per Aircraft (avg.)					
Class 1	280	300	300	300	300
Class 2	140	160	160	160	170
Class 3	16	20	20	20	25
Occupied Seats Per Air-Craft (avg.) (L.F.=0.65)					
Class 1	182.0	195.0	195.0	195.0	195.0
Class 2	91.0	104.0	104.0	104.0	110.5
Class 3	10.4	13.0	13.0	13.0	16.5
Daily Passenger Totals (avg.)					
Class 1	29,911	36,216	38,230	42,337	41,736
Class 2	38,476	44,455	47,009	52,356	47,218
Class 3	1,423	1,609	1,689	1,878	1,809
TOTAL	69,810	82,280	86,928	96,571	90,763
	x60	x60	x60	x60	x60
July-August Passenger Enplanements	4,188,600	4,936,800	5,215,680	5,794,260	5,445,780
TOTAL ÷ % of Yearly totals	÷ 0.25	÷ 0.25	÷ 0.25	÷ 0.25	÷ 0.25
Yearly Passenger Count (Enplanements) x 1000	16,754	19,747	20,862	23,177	21,783

TABLE 8 (cont.)

ANALYSIS of YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
Total Daily Air Carrier and Air Taxi Operations	1448	1473	1556	1729	1502
	x60	x60	x60	x60	x60
	86,880	88,380	93,360	103,740	90,120
July-August Aircraft Operations ÷ % of Yearly Total	÷0.19	÷0.19	÷0.19	÷0.19	÷0.19
Yearly Aircraft Count (Air Carrier and Air Taxi)	457,263	465,157	491,368	546,000	474,315
GA Count	+53,000	+53,000	+53,000	+53,000	+53,000
TOTAL	510,263	518,157	544,368	599,000	527,315

2.3. Experimental Results.

Each experiment produced a summary of hourly results which was reduced to tablular form. The information in the table included: average flow rates for each runway, average total flow rate for the airport, average arrival and departure delays for each runway (including average delay for all runways), average runway crossing delays, average taxiway delays and average gate hold conditions. In addition, average travel times were listed for airborne arrivals (arrival fix to threshold), arrival ground travel (threshold to gate) and departure ground travel (gate to roll including gate hold time). The tables for each experiment are shown in Appendix B.

The summaries of the experiments were used to calculate the total delays and the travel times accumulated during each hour of the simulation. The delay and travel times were added for each experiment (8 hour totals for daytime and 7 hour totals for nighttime). The results of this data reduction are shown in Tables 9 to 11. The tables list sets of experiments which have common weather conditions, traffic flow, etc.

The runway capacity model was exercised during the effort to determine the capacity of the airport during tunnel construction. The results of the experiments (17A, 17B and 17C) are shown in Tables 12 and 13.

The results of the simulation model runs formed the basis for calculation of the annual delays for the airport. Experiment 1 was rerun for a time period from 0700 to 2400 and served as a guide for calculating the total delay for an average day. The results of this simulation, shown in Table ,

Appendix B, indicate that about one-half of the arrival delays for operations from 0700 to 2400 occurred in the first eight hours of the simulation. Delays from the simulation were combined with the delays from the nighttime operations and used to calculate the annual delay. It was assumed that the average day was representative of two months of activity which comprised about 19% of the total delays. The results of the simulation experiments whose conditions matched those required for the annual delay calculation were used as a base for the determination of total annual delay.

TABLE 9

RESULTS OF VFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
1	1978	—	—	NONE	1978	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
7	1982	—	—	NONE	1978	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
7A	1982 +5%	—	—	NONE	1978	1576	66	119	4182	697	4	293	5562	5123	1708	7905	14736
7B	1982 +15%	—	—	NONE	1978	5671	226	105	5541	1591	4	1118	8587	9339	1907	10884	22130
11	1982	—	—	NEAR TERM	1982	1358	123	108	4130	1357	4	1133	6856	4709	1681	8897	15287
11	1982	—	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	1982	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
13	1982	—	—	BY-PASS TO RUNWAY 24R, HOLDING AREA ON TAXIWAY T5	1982	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742
18	1982	—	—	DUAL TAXIWAY	1982	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
18	1982	—	DEPARTURES SENT FROM 25R TO 24R	DUAL TAXIWAY	1982	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
18A	1982	—	"	DUAL TAXIWAY	1982	409	55	62	2190	659	10	3	2980	3748	1629	5175	10552
19A	1982	—	—	TERMINAL EXPANSION	1978	525	39	45	2346	424	8	12	2873	3823	1586	5151	10560

TABLE 9 (cont'd.)

RESULTS OF VFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
20	1982	—	—	TERMINAL EXPANSION	1982	420	48	51	2494	432	8	52	3084	3781	1634	5351	10766
21	1982	—	—	REMOTE TERMINAL	1982	440	46	63	2668	588	6	28	3398	3845	1590	5749	11185
22	1982	—	—	RUNWAY 25R TUNNEL CONSTRUCTION	1978	3073	57	16	4343	355	2	694	5393	6383	1872	7664	15919
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978	993	233	19	4200	1450	11	944	6857	4403	2100	9082	15586
22A	1982	—	11	RUNWAY 25R TUNNEL WITH DUAL TAXIWAY	1978	1034	187	16	4071	1359	11	1048	6694	4444	2101	9001	15547
25	1987	—	—	FAR TERM	1987	189	34	32	1325	245	1	2	1639	3720	1452	3519	8692
25A	1987	—	—	FAR TERM	1987	257	40	38	1957	415	1	73	2524	3899	1505	4455	9859
35	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978	969	65	10	2925	800	0	50	3849	4340	1653	6159	12153

TABLE 10

RESULTS OF IFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
2	1978	—	—	NONE	1978	8235	26	56	2170	100	3	69	2424	11024	1324	4524	16871
2*	1978	44 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	4444	35	60	2895	128	4	315	3437	7610	1548	5597	14755
3*	1978	11	—	NONE	1978	7009	1054	84	9535	241	5	5305	16222	9970	2546	16754	29270
8*	1982	40 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	5100	37	63	2714	164	5	304	3288	8324	1578	5568	15470
8A*	1982 +5%	53 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	7945	36	56	3777	170	1	416	4456	11191	1573	6774	19539
8B*	1982 +15%	61 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978	12703	81	56	5442	297	2	2285	8163	16030	1648	10600	28277
12	1982	—	—	NEAR TERM	1982	5046	55	54	2373	165	3	223	2874	8279	1594	4810	14682
12*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982	2321	50	58	2713	189	6	290	3307	5406	1665	5444	12515
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	131	17	5292	331	7	4318	9948	7353	1757	11343	20452
24	1982	—	—	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5967	108	18	6327	177	0	3112	9741	9595	1893	11386	22874
24	1982	—	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1998	5043	173	20	6020	394	0	4872	11479	8626	1911	13505	36557

* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED

TABLE 10 (cont'd.)

RESULTS OF IFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAYS (minutes)			DEPARTURE DELAYS (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
26	1989	—	—	FAR TERM	1989	831	23	35	1923	88	2	79	2150	4392	1517	4010	9920
36	1982	50 ARRIVALS ON 33R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978	6297	81	14	5315	344	0	3339	9153	9319	1527	11028	21873
37	1982	50 ARRIVALS ON 33L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION (33L COMPLETE)	1978	6535	95	15	5493	328	11	3512	9454	9719	1696	11664	23079

TABLE 11

RESULTS OF VFR -- EASTERLY FLOW AND NIGHTTIME OPERATIONS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
6	1978	—	—	NONE	1978	1405	601	50	3633	1052	3	1010	6349	4851	2094	7842	14787
6*	1978	44 ARRIVALS CHANGED FROM 7R+7L TO 6L	—	NONE	1978	460	166	42	2546	606	0	384	3745	3989	1631	6017	11638
9*	1982	43 ARRIVALS CHANGED FROM 7R+7L TO 6L	—	NONE	1978	408	85	57	2370	406	10	67	3302	3185	1595	5072	10652
16*	1982	"	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982	332	76	62	2271	309	13	65	2795	3898	1602	4898	10399
4*	1978	ALL ARRIVALS PLACED ON 6R	—	NONE	1978	374	3	0	457	5	0	0	465	1358	376	3198	4933
10*	1982	"	—	NONE	1978	1035	4	0	686	15	0	0	705	1986	481	1243	3710
15*	1982	"	—	HIGH SPEED EXITS	1982	844	4	0	617	15	0	0	635	1800	502	1203	3505
5*	1978	ALL ARRIVALS PLACED ON 6R	—	NONE	1978	1245	4	0	1130	5	0	0	1139	2142	466	1647	4255
10A*	1982	"	—	NONE	1982	2048	4	0	1285	13	0	0	1302	3001	497	1825	5323

* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED

TABLE 12

1982 VFR CAPACITY RESULTS -- NO NOISE CONSTRAINTS

24R, 24L and 25L -- MIXED OPERATIONS

NO NOISE RESTRICTIONS

Because of mixed operations on both runways on the north complex, there is an estimated 5% departures capacity loss due to crossover departure paths on the ground. The departure capacity was 35 for the north complex for all arrival percentages (40%, 45%, 50%, 55%, 60%). A 5% departure capacity loss (2 departures) resulted in a departure capacity of 33 on the north complex.

	Hourly Capacity By % Arrivals				
Runways	40%	45%	50%	55%	60%
24R, 24L	99	100	100	101	102
25L	55	55	55	55	55
All 3 Runways	154	155	155	156	157

(Note: The capacity figures listed above reflect the 5% departure capacity loss.)

TABLE 13

1982 VFR CAPACITY RESULTS -- RELAXED NOISE CONSTRAINTS

24R -- ARRIVALS
24L -- DEPARTURES
25L -- MIXED OPERATIONS

The relaxed noise restrictions were the result of running on arrivals on 24R.

Runways	Hourly Capacity By % Arrivals 40%	45%	50%	55%	60%
24R, 24L	91	86	77	70	64
25L	55	55	55	55	55
All 3 Runways	146	141	132	125	119

2.4. Comparison of Experimental Results.

The comparison of experimental results was directed towards satisfying the objectives of the effort and determining:

1. The effects of demand on delay.
2. Peak average delays and annual delay values.
3. Demand versus delay comparisons for increases in total daily demand.
4. The percentage of reduction in delay, travel time and estimated annual delays due to proposed procedures, hardware improvement options and airport design improvements for near-term and long-term implementation.
5. The effects of tunnel construction on delay.
6. The interdependence of terminal facilities, airport design procedures, fleet mix and air traffic demand on airport operations.

The following comparisons were made:

1. 1978 operations with 1982 do-nothing case.
2. 1978 operations with 1982 do-nothing cases varying the 1982 demand.
3. 1982 do-nothing case with 1982 separations and near-term improvements.
4. 1978 operations with the 1987 separations and long-term improvements varying the 1987 demand.
5. Sequences of tunnel construction activities with 1982 do-nothing case.
6. 1982 separations and dual taxiway improvements with 1982 do-nothing case.
7. Near-term improvements with dual taxiway improvement.
8. Departure by-pass around runway 24L with dual taxiway improvement.

9. 1982 do-nothing case with 1982 separations, high speed exits off of runways 6R and 7L and departure by-pass around runway 7L.
10. Do-nothing 1982 case with terminal expansion and the presence and absence of 1982 separations.
11. Remote terminal with dual taxiway improvement.

(NOTE: The 1982 do-nothing case refers to 1978 operations with a 1982 demand.)

COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE

(1978 OPERATIONS USING 1978 and 1982 DEMANDS)

The basis for comparing these simulation experiments (1978 operations) includes all combinations of easterly and westerly traffic flow, VFR and IFR weather conditions, and daytime and nighttime operations under both 1978 and 1982 demands. These configurations represent those exercised during the year at Los Angeles International Airport.

EXPERIMENTS (1978 and 1982 - respective demands)	CONFIGURATIONS
#1 and #7	VFR-Daytime-Westerly Flow
#6(Modified) and #9(Modified)	VFR-Daytime-Easterly Flow
#4(Modified) and #10(Modified)	VFR-Nighttime
#2(Modified) and #8(Modified)	IFR-Daytime-Westerly Flow
#5(Modified) and 10A(Modified)	IFR-Nighttime

Figures 3 through 7 show the average delays for arrival and departure runways. Table 14 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation. The results of each comparison are noted on the table.

Compared to 1978 levels, the 1982 demand, fleet mix and distribution of traffic over the runways and gates produced slightly less delays for VFR conditions, but higher delays and travel times for both IFR weather conditions and nighttime operations.

Tables 15 and 16 show the peak average delays and annual delay estimates for the 1978 operations and the 1982 do-nothing case.

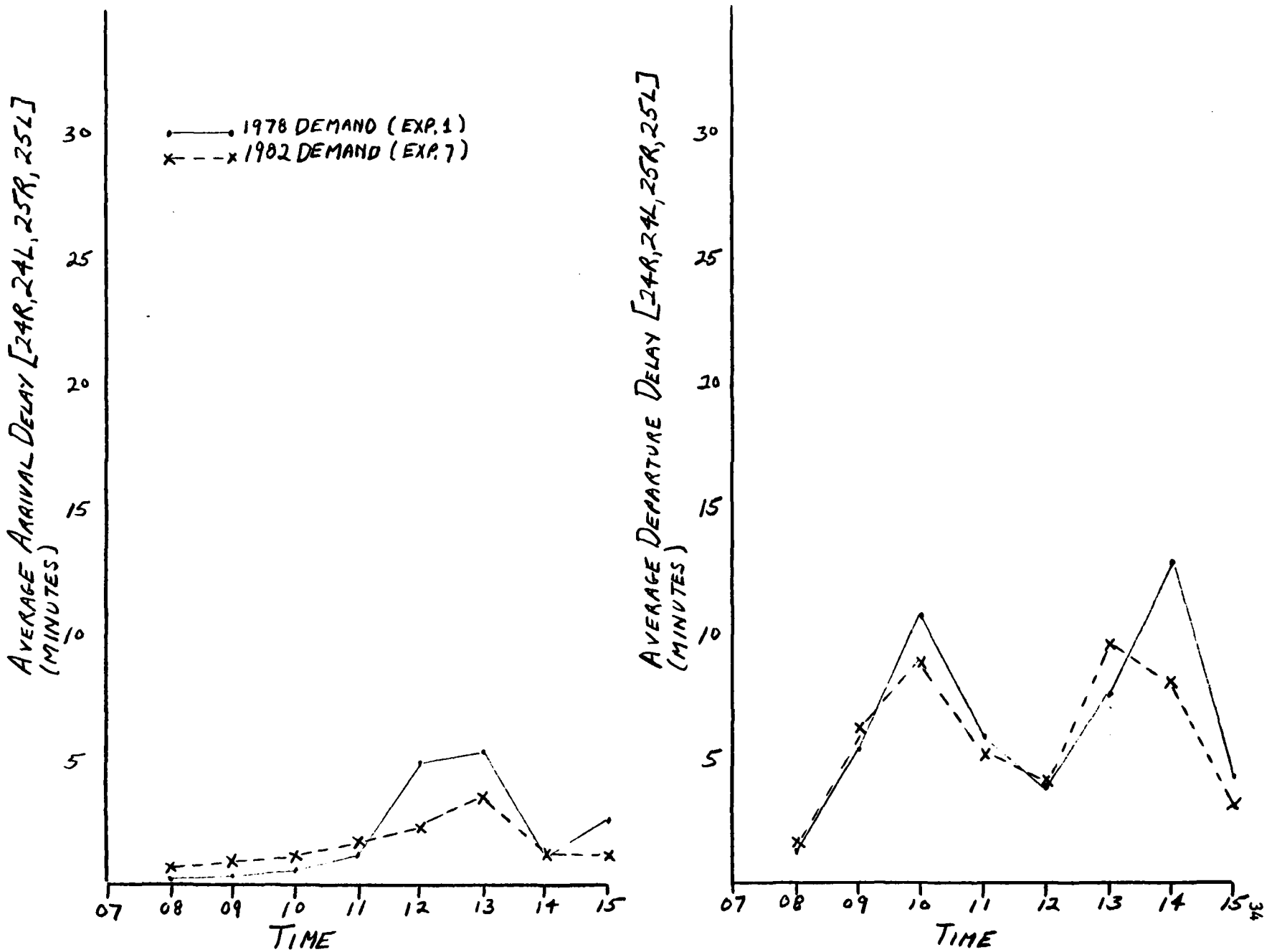

FIGURE 3 EXPERIMENTS #1 and #7
VFR - DAYTIME - WESTERLY FLOW

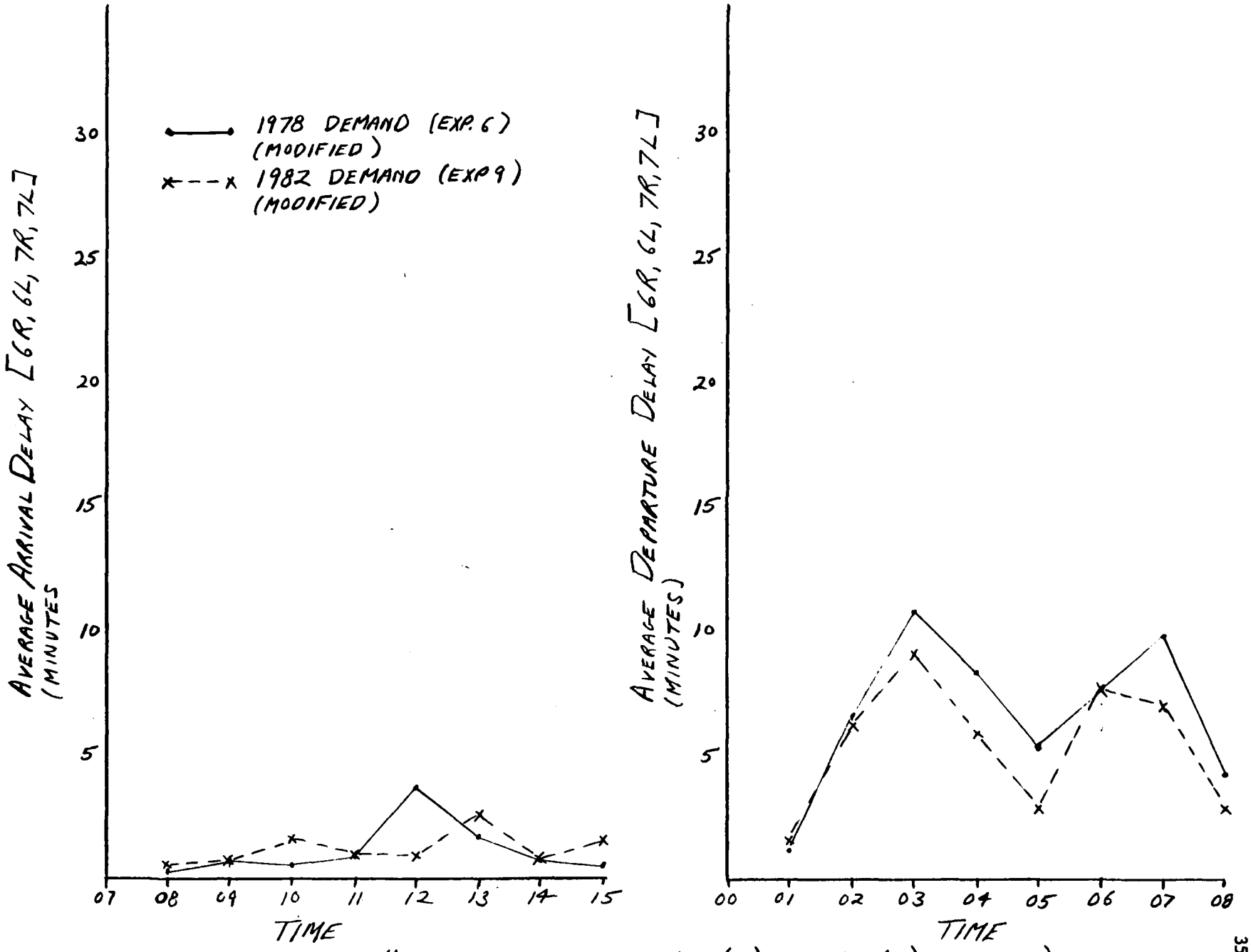

FIGURE 4 EXPERIMENTS #6(M) and #9(M)
VFR - DAYTIME - EASTERLY FLOW

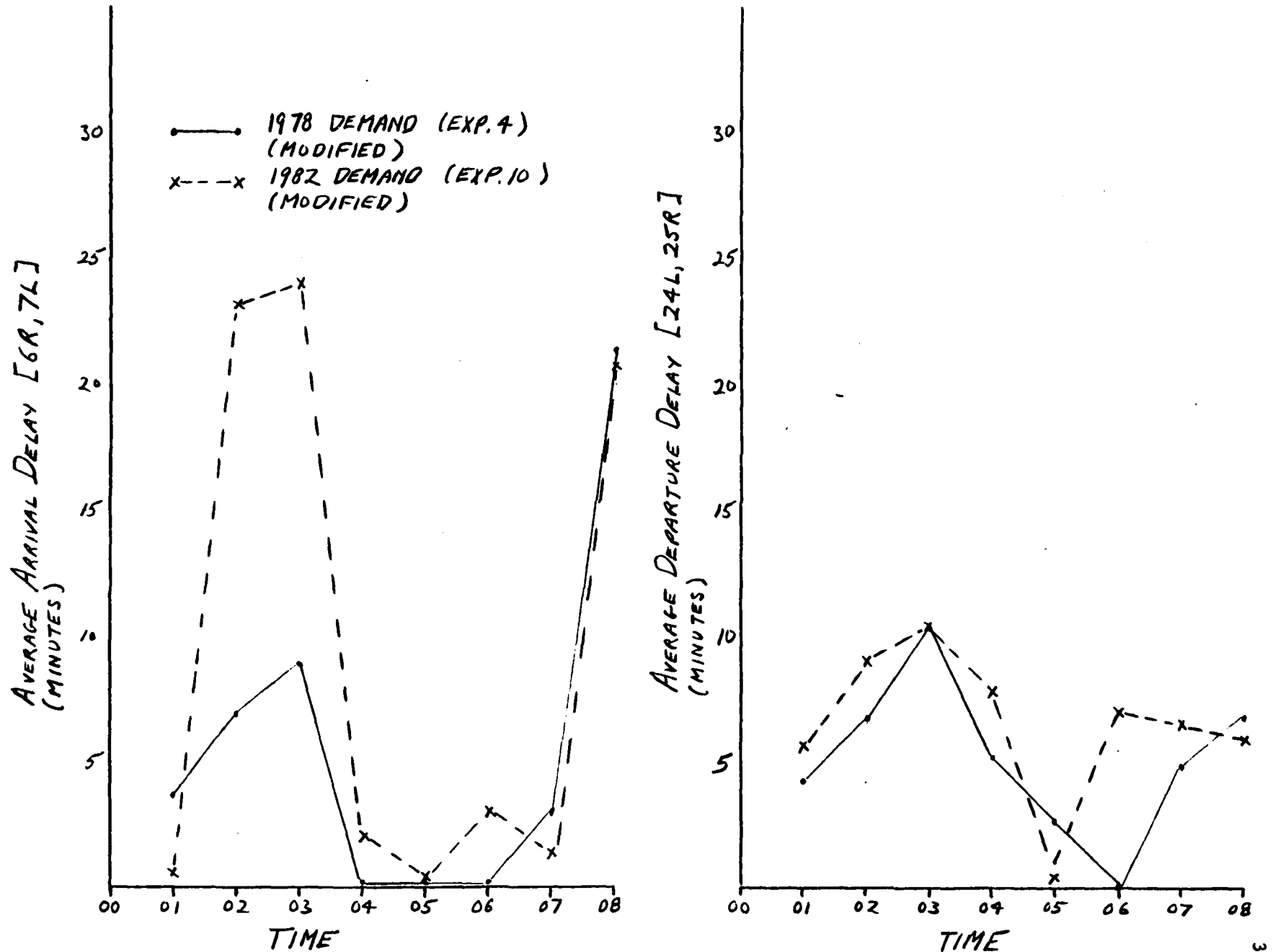

FIGURE 5 EXPERIMENTS #4 (M) and #10 (M)
VFR — NIGHTTIME

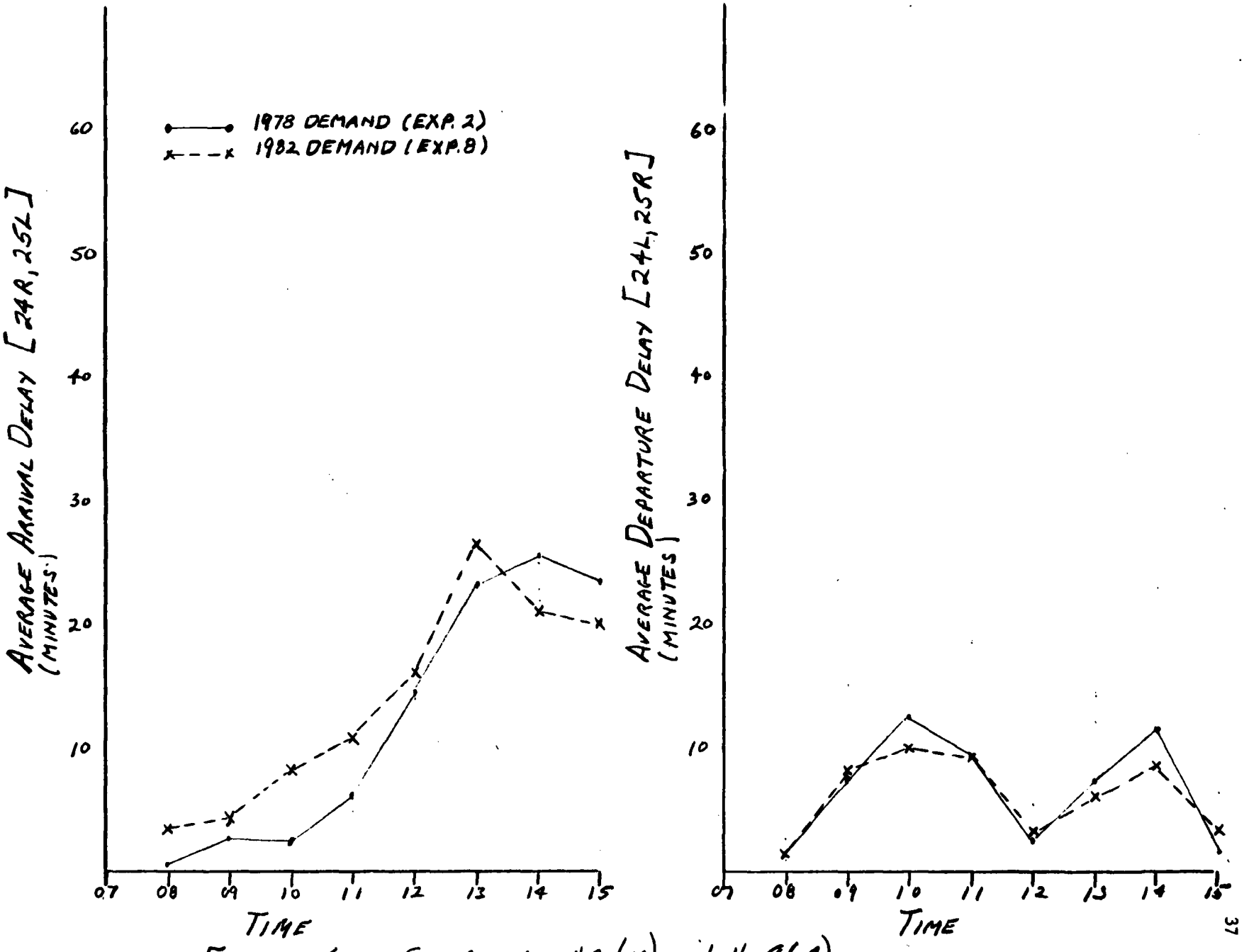

FIGURE 6 EXPERIMENTS #2 (M) and # 8(M)
IFR – DAYTIME – WESTERLY FLOW

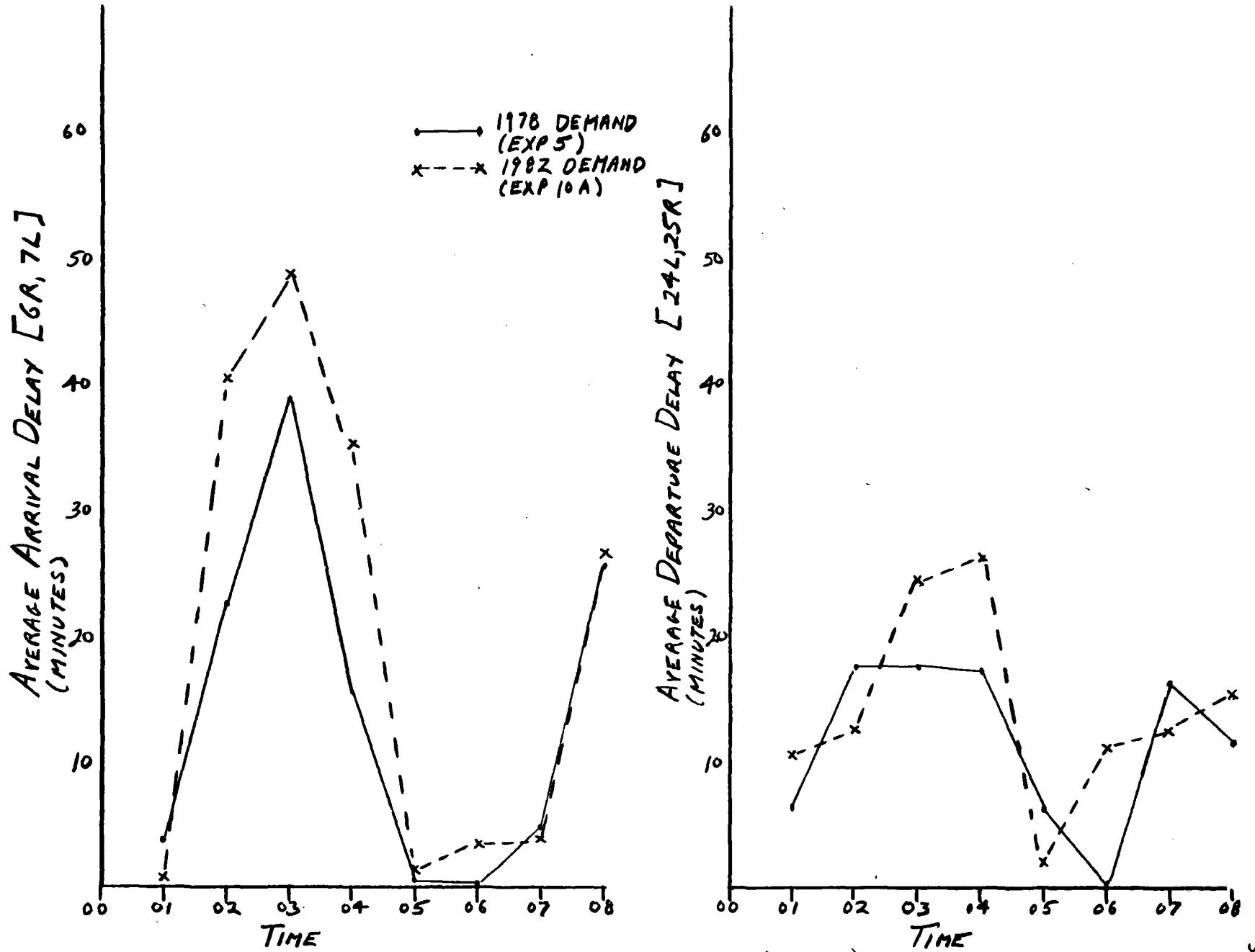

FIGURE 7 EXPERIMENTS #5(M) and #10A (M)
IFR — NIGHTTIME

TABLE 14

1978 OPERATIONS WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
1	1978	—	—	NONE	1978 (VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
7	1982	—	—	NONE	1978 (VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
RESULTS: The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic demand over the runways.																	
6*	1978	44 ARRIVALS CHANGED FROM 33L TO 31	—	NONE	1978 (VFR)	466	166	42	2596	606	0	384	3795	3989	1631	6017	11638
9*	1982	43 ARRIVALS CHANGED FROM 33L TO 31	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3302	3985	1575	5072	10652
RESULTS: The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic demand over the runways.																	
4*	1978	ALL ARRIVALS PLACED ON 4R		NONE	1978 (VFR)	374	3	0	457	5	0	9	465	1358	376	3198	4933
10*	1982	"		NONE	1978 (VFR)	1035	4	0	686	15	0	0	705	1986	481	1243	3710
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																	

* = Modified Demand

TABLE 14 (CONTINUED)

1978 OPERATIONS WITH 1982 DO-MOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
2*	1978	44 ARRIVALS on 25L changed to 27R		NONE	1978 (IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5597	14755
8*	1982	70 ARRIVALS on 25L changed to 27R		NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
RESULTS: The 1982 demand resulted in greater arrival delays and reduced departure delays.																	
5*	1978	ALL ARRIVALS PLACED ON 6R		NONE	1978 (IFR)	1245	4	0	1130	5	0	0	1139	2142	466	1647	4255
10A*	1982	"		NONE	1978 (IFR)	2048	4	0	1285	13	0	0	1302	3001	497	1825	5323
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																	

* = Modified Demand

TABLE 15

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DEPARTURE
1	1978	VFR	NONE	1978	5.3	12.7
7	1982	VFR	NONE	1978	3.5	9.5
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
					NIGHTTIME DELAY ARRIVAL	DEPARTURE
4	1978	VFR	NONE	1978	8.9	10.3
10	1982	VFR	NONE	1978	24.1	10.2
5	1978	IFR	NONE	1978	38.9	17.6
10A	1982	IFR	NONE	1978	48.8	26.1

TABLE 16

ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,270	26,359	39,630
				ANNUAL OPERATIONS TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
7,8 & 10	1982	NONE	1978	518		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6

COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

(1978 OPERATIONS USING 1978 AND VARIED 1982 DEMAND)

The basis for comparing these simulation experiments (1978 daytime operations) includes the VFR and IFR weather conditions for the westerly traffic flow under these various demands - 1978 demand, 1982 demand, a 5% increase in the 1982 demand and a 15% increase in the 1982 demand.

EXPERIMENTS (1978, 1982, 1982 +5%, 1982 +15%, respectively)	CONFIGURATIONS
#1, #7, #7A and #7B	VFR-Daytime-Westerly Flow
#2(Modified), #8(Modified), #8A(Modified) and #8B(Modified)	IFR-Daytime-Westerly Flow

Figures 8 and 9 show the average delays for arrival and departure runways. Table 17 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation. The result of each comparison is noted in the table.

The effects of the 1982 demands on the peak average delays and the annual delay estimates are shown in Tables 18 and 19.

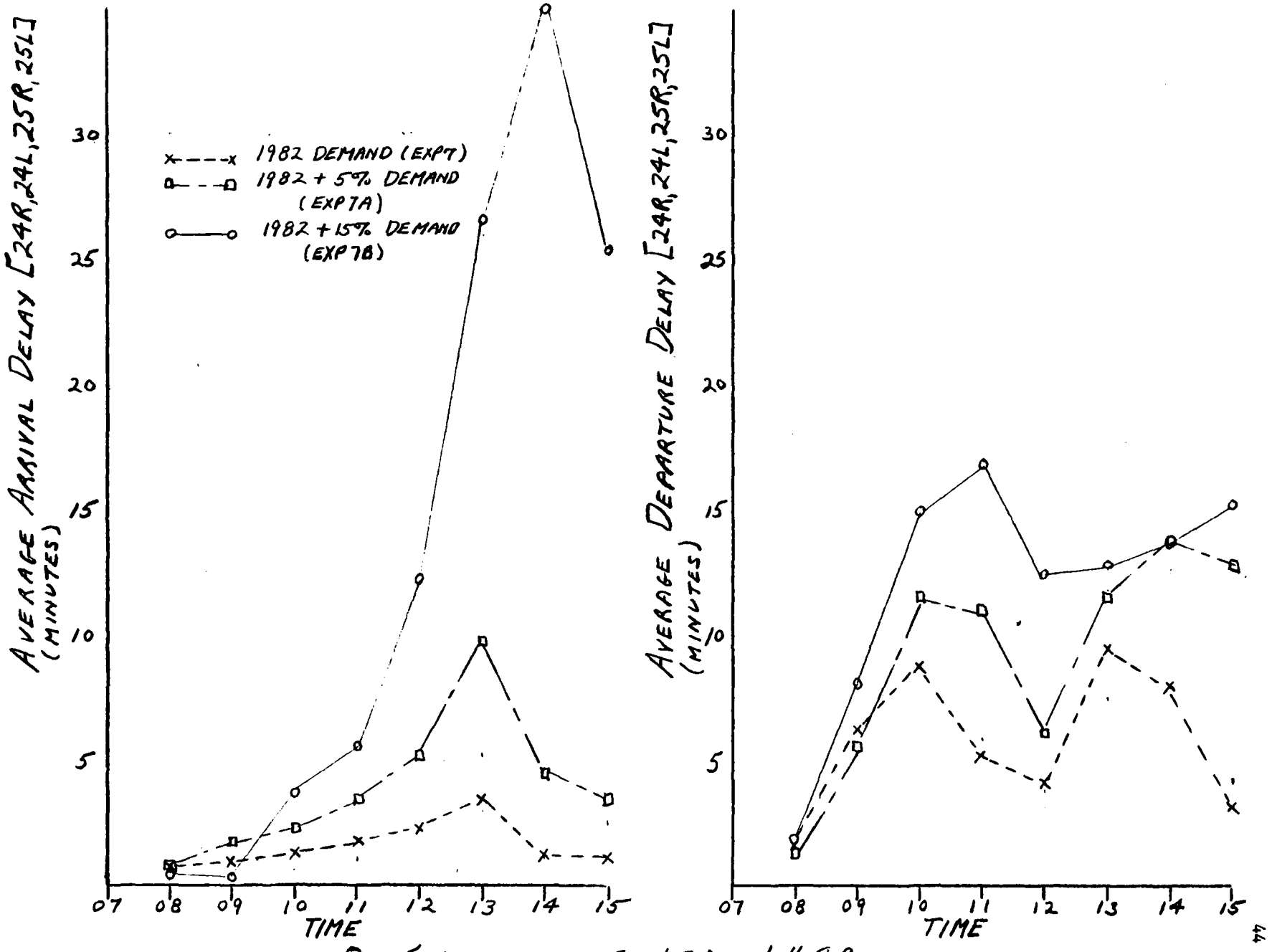

FIGURE 8 EXPERIMENTS # 1, # 7A and # 7B
VFR-DAYTIME- WESTERLY FLOW

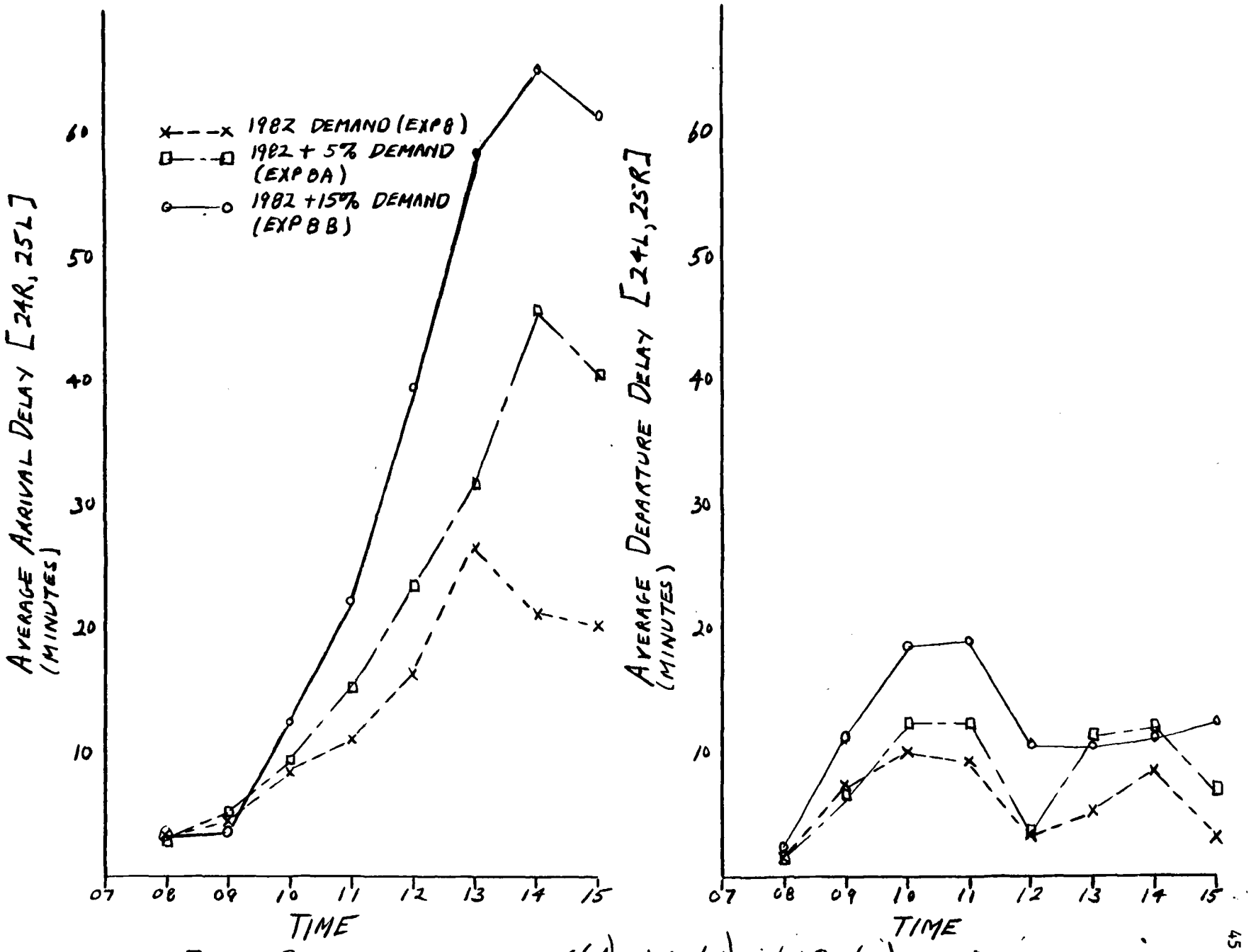

FIGURE 9 EXPERIMENTS #8(M), #8A(M) and #8B(M)
IFR - DAYTIME - WESTERLY FLOW

TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes) RUNWAY AIR	ARRIVAL DELAY (minutes) TAXI	ARRIVAL DELAY (minutes) RUNWAY X-ING	DEPARTURE DELAY (minutes) RUNWAY	DEPARTURE DELAY (minutes) TAXI	DEPARTURE DELAY (minutes) RUNWAY X-ING	DEPARTURE DELAY (minutes) GATE	TOTAL GROUND DELAYS	TRAVEL TIMES (minutes) ARRIVAL AIR	TRAVEL TIMES (minutes) ARRIVAL GROUND	TRAVEL TIMES (minutes) DEPARTURES GROUND	TRAVEL TIMES (minutes) TOTAL
	—	—	NONE	1978(VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
	—	—	NONE	1978(VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
		—	NONE	1978(VFR)	1576	66	119	4182	897	4	293	5562	5623	1708	7905	14736
	—	—	NONE	1978(VFR)	5671	226	105	5541	1591	4	1118	8587	9339	1907	10884	22130
	44 ARRIVALS ON 25L CHANGED TO 28R	—	NONE	1978(IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5397	14755
	90 ARRIVALS ON 25L CHANGED TO 28R	—	NONE	1978(IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
	53 ARRIVALS ON 25L CHANGED TO 28R	—	NONE	1978(IFR)	7945	36	56	3777	170	1	416	4456	11191	1573	6774	19539
	CIRRIVALS ON 25L CHANGED TO 28R	—	NONE	1978(IFR)	12703	81	56	5442	297	2	2285	8163	16030	1648	10600	28277

RESULTS: The 1982 DO-NOTHING CASE resulted in progressively higher arrival and departure delays as the demand was increased by 5% and 15%.

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DEPARTURE
1	1978	VFR	NONE	1978	5.3	10.6
7	1982	VFR	NONE	1978	3.5	9.5
7A	1982+ 5%	VFR	NONE	1978	9.9	13.8
7B	1982+15%	VFR	NONE	1978	35.7	16.9
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
8A	1982+ 5%	IFR	NONE	1978	45.8	12.1
8B	1982+15%	IFR	NONE	1978	65.1	19.0

TABLE 19

ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,271	26,359	39,630
7A,8A	1982+ 5%	NONE	1978	21,085	35,204	56,289
7B,8B	1982+15%	NONE	1978	75,102	55,035	130,137
				ANNUAL OPERATIONS TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
7,8 & 10	1982	NONE	1978	518		
7A,8A	1982+ 5%	NONE	1978	544		
7B,8B	1982+15%	NONE	1978	599		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
7A,8A	1982+ 5%	NONE	1978	4.7	7.8	6.2
7B,8B	1982+15%	NONE	1978	15.0	11.0	13.0

COMPARISON OF 1982 DO-NOTHING CASF WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

A 1982 demand is used in all the simulation experiments comparing the 1982 do-nothing case (i.e., 1978 operations) with the 1982 separations and near-term improvements. The basis of these comparisons includes the VFR and IFR weather conditions for the westerly flow of traffic and the VFR conditions for the easterly flow.

EXPERIMENTS (Do-nothing and near-term, respectively)	CONFIGURATIONS
#7 and #11(Rerouted)	VFR-Daytime-Westerly Flow
#9(Modified) and #16(Modified)	VFR-Daytime-Easterly Flow
#8(Modified) and #12(Modified and rerouted)	IFR-Daytime-Westerly Flow

The results of the experiments are shown in Figures 10 through 14 and Table 20. The figures show the average delays for arrival and departure runways. Included in the figures are the initial results from experiments #11 and #12 demonstrating the necessity to reroute departures to the north complex when delays start to build on the south runways. The table shows a direct comparison of the experiments and the effects of the improvements on delay and travel times.

The peak average delay and the annual delay estimates are shown in Tables 21 and 22.

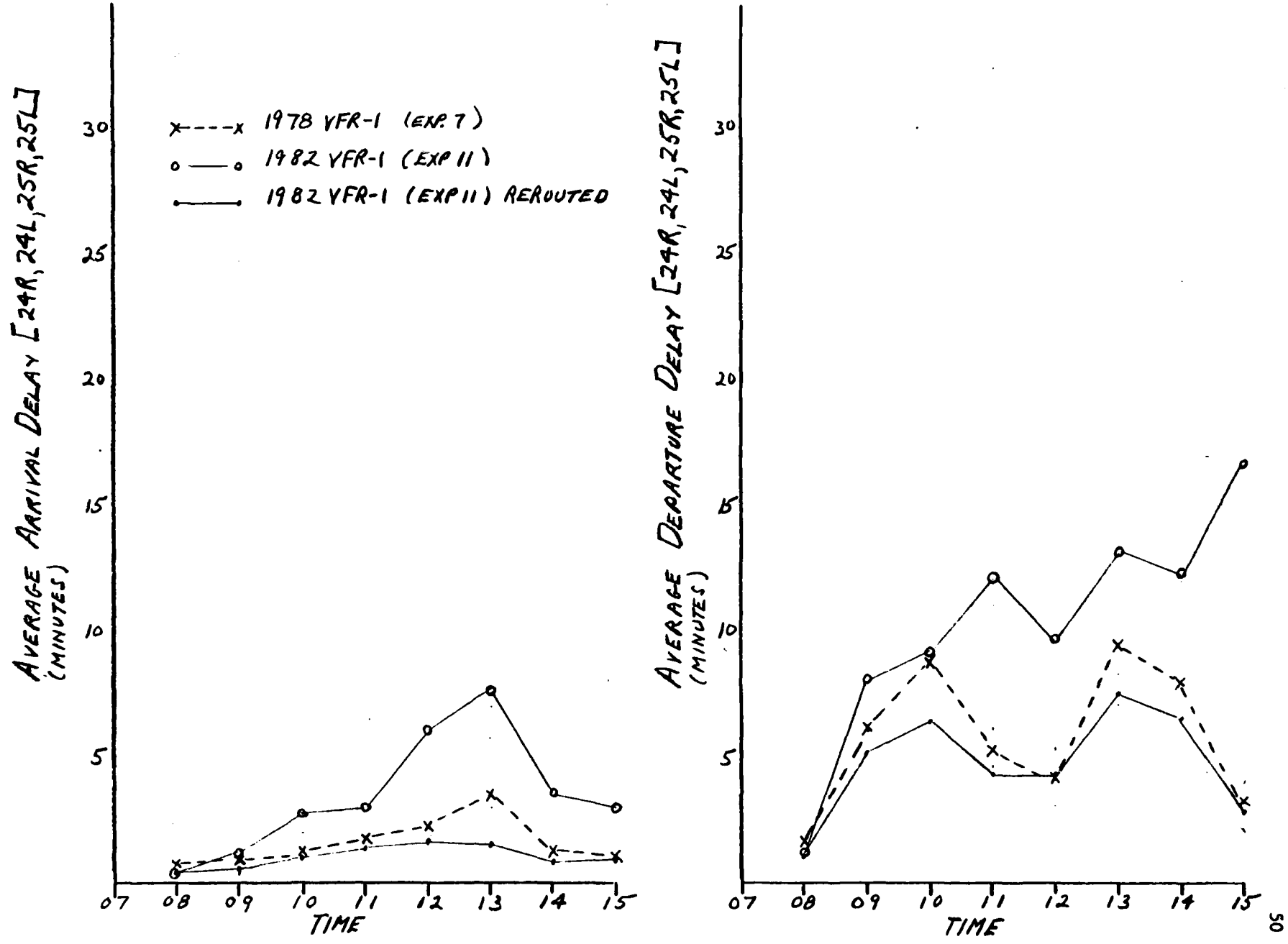

FIGURE 10 EXPERIMENTS #9 and #11 – DELAYS
VFR - DAYTIME - WESTERLY FLOW

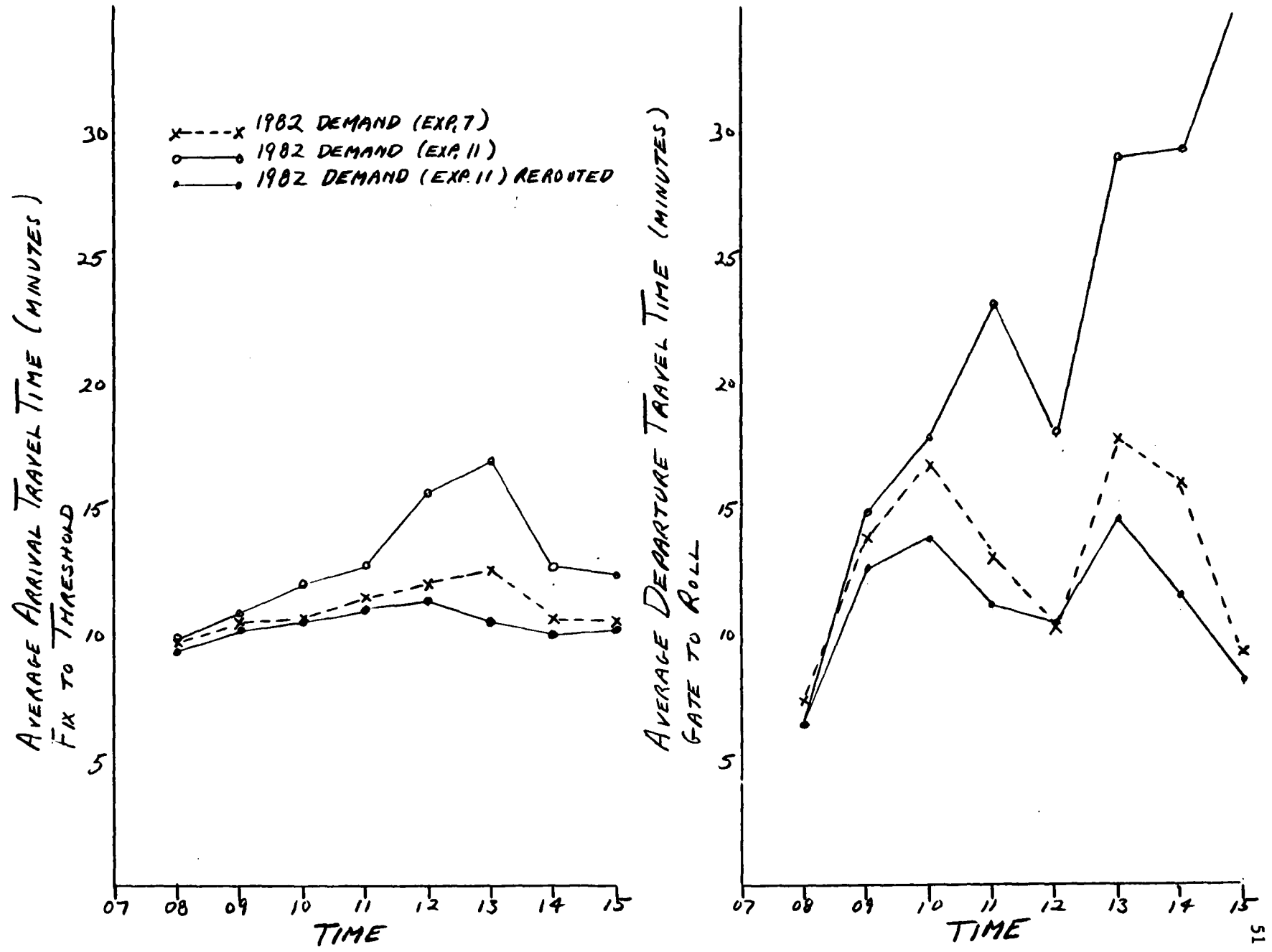

FIGURE 11 EXPERIMENTS #7 and #11 - TRAVEL TIMES
VFR- DAYTIME - WESTERLY FLOW

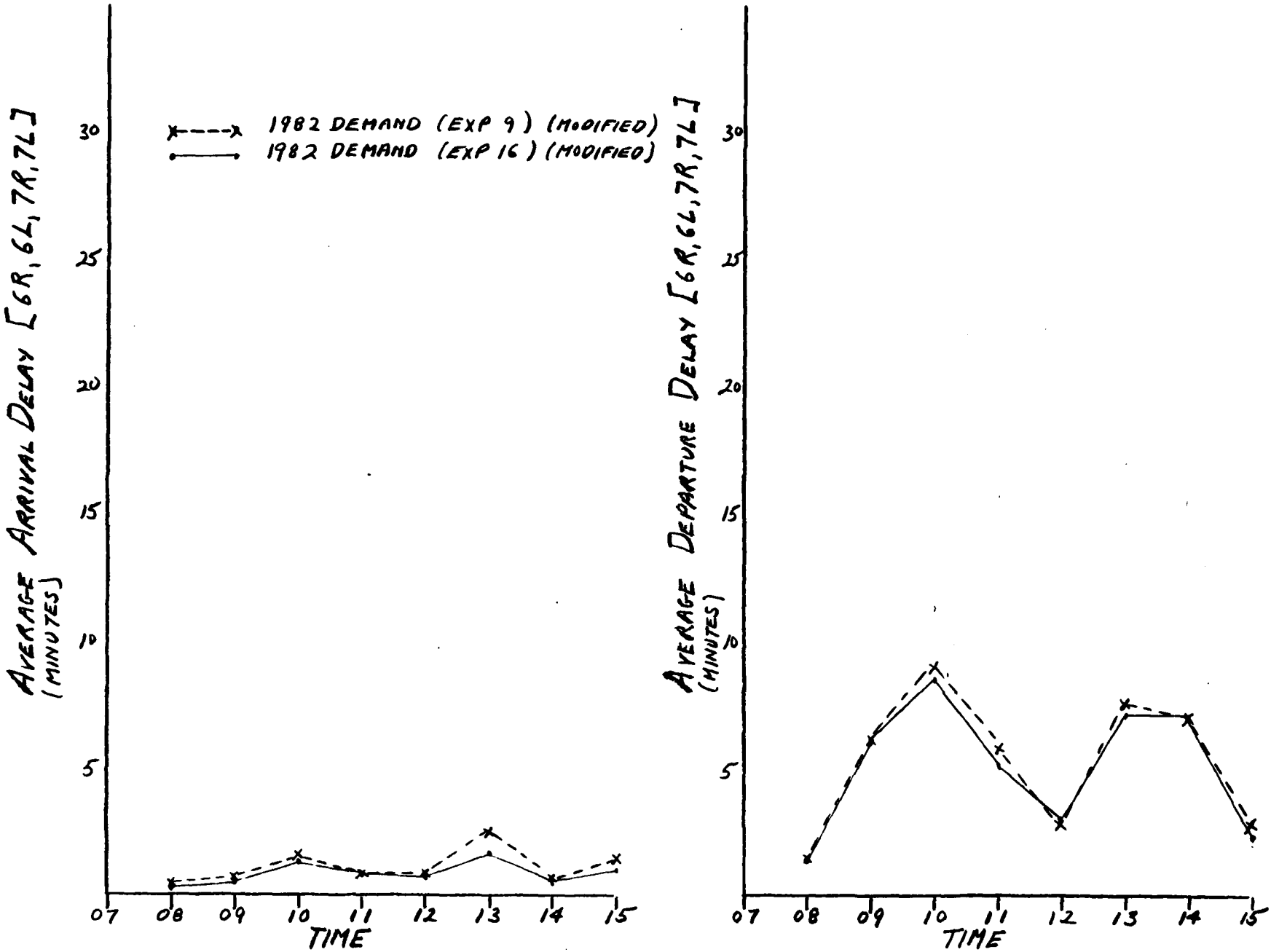

FIGURE 12 EXPERIMENTS #9(M) and #16(M)
VFR-DAYTIME-EASTERLY FLOW

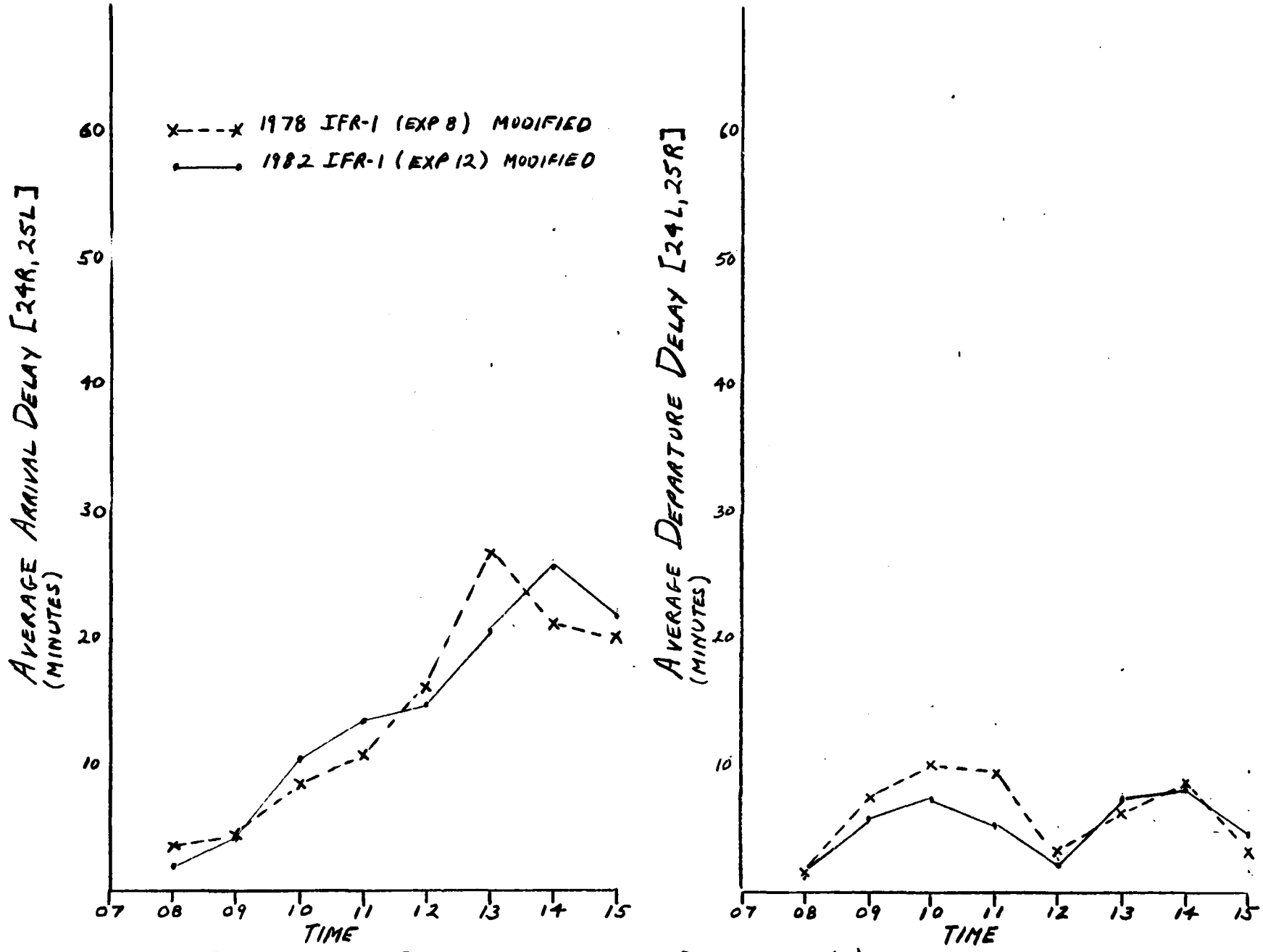

FIGURE 13 EXPERIMENTS #8(M) and #12(M) - DELAYS
IFR - DAYTIME - WESTERLY FLOW

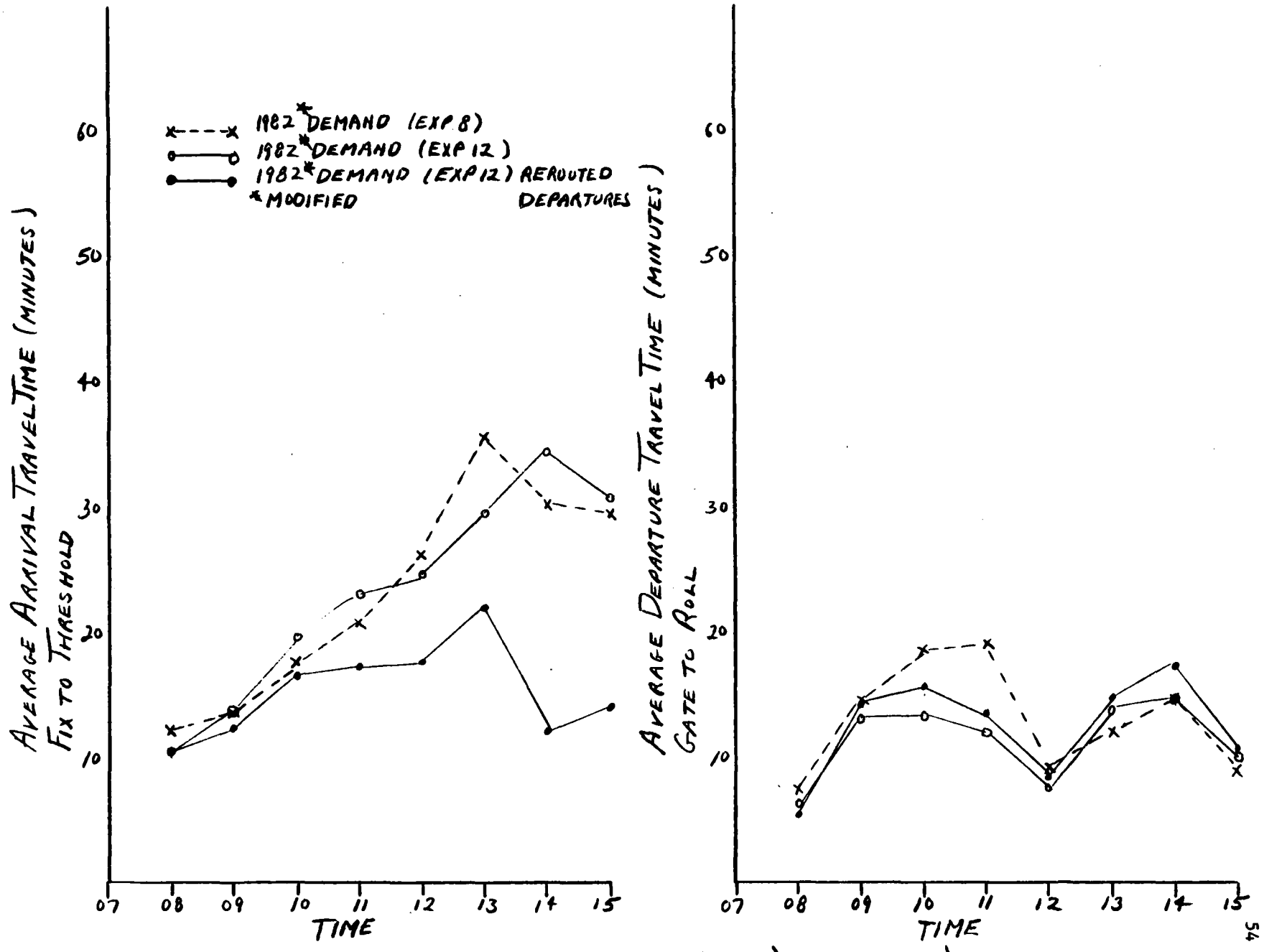

FIGURE 14 · EXPERIMENTS #8(M) and #12(M) - TRAVEL TIMES
IFR - DAYTIME - WESTERLY FLOW

TABLE 20

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
7	1982	—	—	NONE	1978 (VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
11	1982	—	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	1982 (VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival and departure delays.																	
* 9	1982	43 ARRIVALS CHANGED FROM 7R TO 7L	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3302	3985	1595	5072	10652
* 16	1982	"	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982 (VFR)	332	76	62	2271	309	13	65	2795	3898	1602	4898	10399
RESULTS: The high speed exits, runway 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.																	
* 8	1982	40 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5700	39	63	2714	164	5	304	3288	8324	1578	5588	15470
* 12	1982	50 ARRIVALS ON 25L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982 (IFR)	2321	50	58	2713	189	6	290	3307	5906	1665	5444	12515
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival delays.																	

* = Modified Demand

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DEPARTURE
7	1982	VFR	NONE	1978	3.5	9.5
11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
8*	1982	IFR	NONE	1978	26.6	10.0
12*	1982	IFR	NEAR-TERM	1982	25.5	8.3

* = Modified Demand

** = Rerouted Departures

TABLE 22

ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
7,8 & 10	1982	NONE	1978	13,270	26,359	39,630
11,12	1982	NEAR-TERM	1982	4,389	16,646	21,036
				ANNUAL OPERATIONS TOTAL X 1000		
7,8 & 10	1982	NONE	1978	518		
11,12	1982	NEAR-TERM	1982	518		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
11,12	1982	NEAR-TERM	1982	1.0	3.9	2.4

COMPARISON OF 1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

The basis for comparing the 1978 operations with the 1987 separations and long-term improvements includes the VFR and IFR weather conditions for the westerly traffic flow during the daytime - under demands for 1978, 1987 and 1987 with 10% greater peaks.

EXPERIMENTS (1978, 1987, 1987 with peaks, respectively)	CONFIGURATIONS
#1, #25 and #25A	VFR-Daytime-Westerly Flow
#2(Modified) and #26	IFR-Daytime-Westerly Flow

The results of the experiments are shown in Table 23. The peak average delays, Table 24, and the estimated annual delays, Table 25, under the various demands (1978, 1987 and 1987 with 10% greater peaks) show substantial improvement in delay.

TABLE 23

1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
1	1978	—	—	NONE	1978(VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
25	1987	—	—	FAR TERM	1987(VFR)	189	34	32	1325	245	1	2	1639	3720	1452	3519	8692
25A	1987 +10%	—	—	FAR TERM	1987(VFR)	257	40	38	1957	415	1	73	2524	3899	1505	4455	9859
RESULTS: The FAR-TERM improvements and 1987 VFR separations resulted in substantial reductions of arrival and departure delays.																	
2*	1978	44 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978(IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5597	14755
26	1987	—	—	FAR TERM	1987(IFR)	831	23	35	1923	88	2	79	2150	4392	1577	4010	9920
RESULTS: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.																	

* - Modified Demand

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TABLE 24

PEAK AVERAGE DELAY (AVERAGE DAY)
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY ARRIVAL	DEPARTURE
1	1978	VFR	NONE	1978	5.3	10.6
25	1987	VFR	FAR-TERM	1987	0.6	5.0
25A	with 1987peaks	VFR	FAR-TERM	1987	0.9	7.9
2	1978	IFR	NONE	1978	25.7	12.5
26	1987	IFR	FAR-TERM	1987	4.6	7.0

TABLE 25

ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
25,26	1987	FAR-TERM	1987	2,148	11,348	13,496
				ANNUAL OPERATIONS TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
25,26	1987	FAR-TERM	1987	527		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
25,26	1987	FAR-TERM	1987	0.5	2.6	1.5

COMPARISONS OF SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

The basis for comparing the possible sequences of tunnel construction activities includes: the availability of the dual taxiway during the closure of runway 25R during VFR weather with and without the completion of runway 25L, and the closure of a runway (25R or 25L) during IFR weather with and without the completion of the other runway.

EXPERIMENTS (Do-nothing and activity, respectively)	CONFIGURATIONS
#7 and #22A	VFR-Daytime-Westerly Flow
#7 and #22(rerouted)	VFR-Daytime-Westerly Flow
#22(rerouted) and #35(rerouted)	VFR-Daytime-Westerly Flow
#8(modified) and #23(rerouted)	IFR-Daytime-Westerly Flow
#8(modified) and #24(rerouted)	IFR-Daytime-Westerly Flow
#23(rerouted) and #36(rerouted)	IFR-Daytime-Westerly Flow
#24(rerouted) and #37(rerouted)	IFR-Daytime-Westerly Flow

The results of the experiments are shown in Table 26. There is a series of experiments performed under both VFR and IFR weather conditions in which runway 25R is closed for tunnel construction, and then after its completion, runway 25L is closed. Under IFR weather conditions, there

is a sequence of experiments in which runway 25L is closed for tunnel construction, and then, after its completion, runway 25R is closed. The effect of the dual taxiway during tunnel construction on 25R, under VFR conditions, is shown in experiment #22A.

TABLE 26

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
7	1982	—	—	NONE	1978 (VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (VFR)	993	233	19	4200	1450	11	944	6857	4903	2100	9082	15586
22A	1982	—	11	RUNWAY 25R TUNNEL CONSTRUCTION WITH DUAL TAXIWAY	1978 (VFR)	1034	187	16	4071	1359	11	1048	6694	4444	2101	9001	15547
35*	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (VFR)	969	65	10	2925	800	0	50	3849	4340	1653	6159	12153
RESULTS: Experiment #22-- Runway 25R tunnel construction resulted in larger departure delays (about 56%). Experiment #22A-- The availability of the dual taxiway system during tunnel construction reduced the taxi delays. Experiment #35-- Runway 25L tunnel construction after the completion of runway 25R resulted in less delay compared to the delays during the tunnel construction on runway 25R (Experiment #22).																	
8*	1982	40 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (IFR)	4776	131	17	5292	331	7	1318	9998	7353	1757	11343	20452
36*	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (IFR)	6297	81	14	5375	344	0	3339	9153	9319	1527	11028	21873
RESULTS: Experiment #23-- Runway 25R tunnel construction resulted in larger departure delays during IFR weather. Experiment #36-- Runway 25L tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #23.																	

* = Modified Demand

TABLE 26 (CONTINUED)

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
* 8	1982	40 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3283	8324	1578	5568	15470
24	1982	—	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978 (IFR)	5043	173	20	6020	394	0	4872	11479	8626	1911	13505	36537
* 37	1982	56 ARRIVALS ON 25L CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION (25L COMPLETE)	1978 (IFR)	6535	95	15	5493	328	11	3512	9454	9719	1696	11664	23079

RESULTS: Experiment #24-- Runway 25L tunnel construction resulted in larger departure delays during IFR weather.
(Experiment #24 compared to Experiment #23 indicated that the construction of runway 25L produced larger delays than the initial construction of runway 25R.)
Experiment #37-- Runway 25R tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #24.

COMPARISON OF 1982 SEPARATIONS AND DUAL TAXIWAY IMPROVEMENT WITH 1982 DO-NOTHING CASE

The basis for determining the effect of the dual taxiway on delays and travel times includes a comparison of the 1982 do-nothing case (experiment #7) with experiment #18 (1982 separations with dual taxiway). Both experiments have identical 1982 demands.

EXPERIMENTS	CONFIGURATION
(Do-nothing vs. separations and taxiway)	
#7 and #18	VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF NEAR-TERM IMPROVEMENTS WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the percentage (%) of reduction of departure ground travel times for the near-term improvements includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #18 (rerouted) has a dual taxiway improvement and experiment #11 (rerouted) has the near-term improvements (tunnel construction, by-pass around 24L to runway 24R, high speed exit from runway 25L to the south, etc.). These experiments, similar in demand and separations, permit isolation of the effects of the near-term improvements since a previous comparison has shown that the dual taxiway shows no improvement under the 1982 demand.

EXPERIMENTS	CONFIGURATION
(Dual taxiway and near-term, respectively)	
#18(rerouted) and #11(rerouted)	VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF DEPARTURE BY-PASS AROUND RUNWAY 24L WITH DUAL TAXIWAY IMPROVEMENTS

The basis for determining the percentage (%) of improvement for the departure by-pass around runway 24L to runway 24R involves a comparison of experiment #13 with experiment #18 (dual taxiway improvement). Since both experiments have identical 1982 demands and 1982 separations and a previous comparison shows no improvement due to the dual taxiway for the 1982 demand, this comparison isolates the effect of the by-pass.

EXPERIMENTS (Dual taxiway and by-pass, respectively)	CONFIGURATION
#18 and #13	VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

TABLE 27

IMPROVEMENT COMPARISONS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
7	1982	—	—	NONE	1978 (VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
18	1982	—	—	DUAL TAXIWAY	1982 (VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
RESULTS: The dual taxiway system and the 1982 separations resulted in reduced arrival delays. No change was noted in the taxi delays.																	
18	1982	—	DEPARTURES SENT FROM 25R TO 24R	DUAL TAXIWAY	1982 (VFR)	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
11	1982	—	11	NEAR TERM	1982 (VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements resulted in reduced departure delays.																	
18	1982	—	—	DUAL TAXIWAY	1982 (VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
13	1982	—	—	BY-PASS TO RUNWAY 24R, HOLDING AREA ON TAXIWAY 75	1982 (VFR)	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742
RESULTS: The by-pass to runway 24R and the holding area on taxiway 75 resulted in reduced departure delays.																	

COMPARISON OF 1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OFF OF RUNWAYS 6R and 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L

The basis for determining the effect on delays and travel times of the 1982 separations, the high speed exits off of runways 6R and 7L, and the departure by-pass around runway 7L to runway 7R includes a comparison of experiments #6(M), #9(M) and #16(M). Experiment #6 (with modified arrival demand) is the base case with 1978 separation values. Experiments #9(M) and #16(M) have the 1982 demand (with modified arrival demand) but differ with respect to the improvements noted above

EXPERIMENTS	CONFIGURATION
(1978, do-nothing and improvements - respectively)	
#6(M), #9(M) and #16(M)	VFR-Daytime-Easterly Flow

The results of these experiments are shown in Table 28.

TABLE 28

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OFF RUNWAYS 6R AND 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
6*	1978	44 ARRIVALS CHANGED FROM 7R & 7L TO 6L	—	NONE	1978 (VFR)	460	166	42	2546	606	0	384	3745	3989	1631	6017	11638
9*	1982	23 ARRIVALS CHANGED FROM 7R & 7L TO 6L	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3302	3985	1595	5072	10652
16*	1982	11	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982 (VFR)	332	76	62	2271	309	13	65	2795	3898	1602	4898	10399

RESULTS: Experiment 9-- The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and and the distribution of the air traffic demand over the runways.
Experiment 16-- The 1982 demand, the high speed exits and the runway 7L by-pass showed an even greater reduction in arrival and departure delays than did Experiment 9.

* = Modified Demand

COMPARISON OF 1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS

The basis for determining the effect of terminal expansion (with and without the 1982 separations) on delays includes a comparison of the 1982 do-nothing case (experiment #7) with experiments #19A and #20. All of these experiments have 1982 demands.

EXPERIMENTS (Do-nothing vs. expansion vs. expansion and separations, respectively)	CONFIGURATION
#7, #19A and #20	VFR-Daytime-Westerly Flow

The results of these experiments are shown in Table 29.

TABLE 29

1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
7	1982	—	—	NONE	1978(VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5657	11296
19A	1982	—	—	TERMINAL EXPANSION	1978(VFR)	525	39	45	2346	424	8	12	2873	3823	1586	5157	10580
20	1982	—	—	TERMINAL EXPANSION	1982(VFR)	420	48	51	2494	432	8	52	3084	3781	1634	5351	10766

RESULTS: Experiment 19A-- Terminal expansion resulted in a reduction in departure delays due to the distribution of the air traffic demand over the runways.
Experiment 20-- Terminal expansion with 1982 separations resulted in reduced arrival and departure delays compared to Experiments 7 and 19A. (Experiment 20 had the lowest arrival delays and Experiment 19A had the lowest departure delays.)

COMPARISON OF REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the effect of a remote terminal improvement includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #21 has a remote terminal added for international flights and a new distribution of traffic to and from the gate areas. Since experiment #18 (with the dual taxiway system) showed no improvement over the 1982 do-nothing case, a comparison of experiments #18 and #21 isolates the effect of the remote terminal.

EXPERIMENTS (Dual taxiway and remote terminal, respectively)	CONFIGURATION
#18 and #21	VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 30.

TABLE 30

REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)				TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
18	1982	—	—	DUAL TAXIWAY	1982(VFR)	516	48	59	2626	581	9	27	3331	3914	1623	5705	11242
21	1982	—	—	REMOTE TERMINAL	1982(VFR)	440	46	63	2668	588	6	28	3398	3845	1590	5749	11185

RESULTS: The remote terminal resulted in reduced arrival delays and slightly increased departure delays.

2.5. Analysis of Results (interpretation)

The results of the experiments performed under the delay studies of the Los Angeles International Airport Task Force have demonstrated the relationship of air traffic demand and delay, and identified the delay reduction benefits of various near-term and far-term improvements.

Several performance measurements have been introduced to indicate the changes which occur as improvements are introduced into both the air traffic control scenario and the airport design. These measures include the peak average delays, the annual delay estimates, the total delays and the travel times during a simulated time period. They are calculated under different estimates of air traffic demand and operating conditions.

In additon, the estimated demands are periodically compared with the actual demand encountered at the facility.

Table 31 is a summary of annual delay estimates for the various demands, the ATC system scenarios and the improvements. The results are plotted in Figure 15 to illustrate both past and present operating conditions at the airport. Projected points on the curves are calculated using the percentages of improvement in delay attributed to the near-term or far-term conditions of both the ATC scenario and the airport design. Markers are set on the scale to show the actual demands encountered in 1978 and 1979.

TABLE 31

SUMMARY OF ANNUAL DELAYS (ESTIMATES)

DEMAND	ATC SYSTEM SCENARIO	IMPROVEMENTS	ANNUAL DELAY (HOURS)
1978	1978	none	37,991
1982	1978	none	39,630
1982 + 5%	1978	none	56,289
1982 +15%	1978	none	130,137
1982	1982	none	33,953
1982	1978	1982	33,150
1982	1982	1982	21,036
1987	1978	none	41,339
1987	1978	1987	31,500
1987	1987	none	13,496
1987	1987	1987	13,496

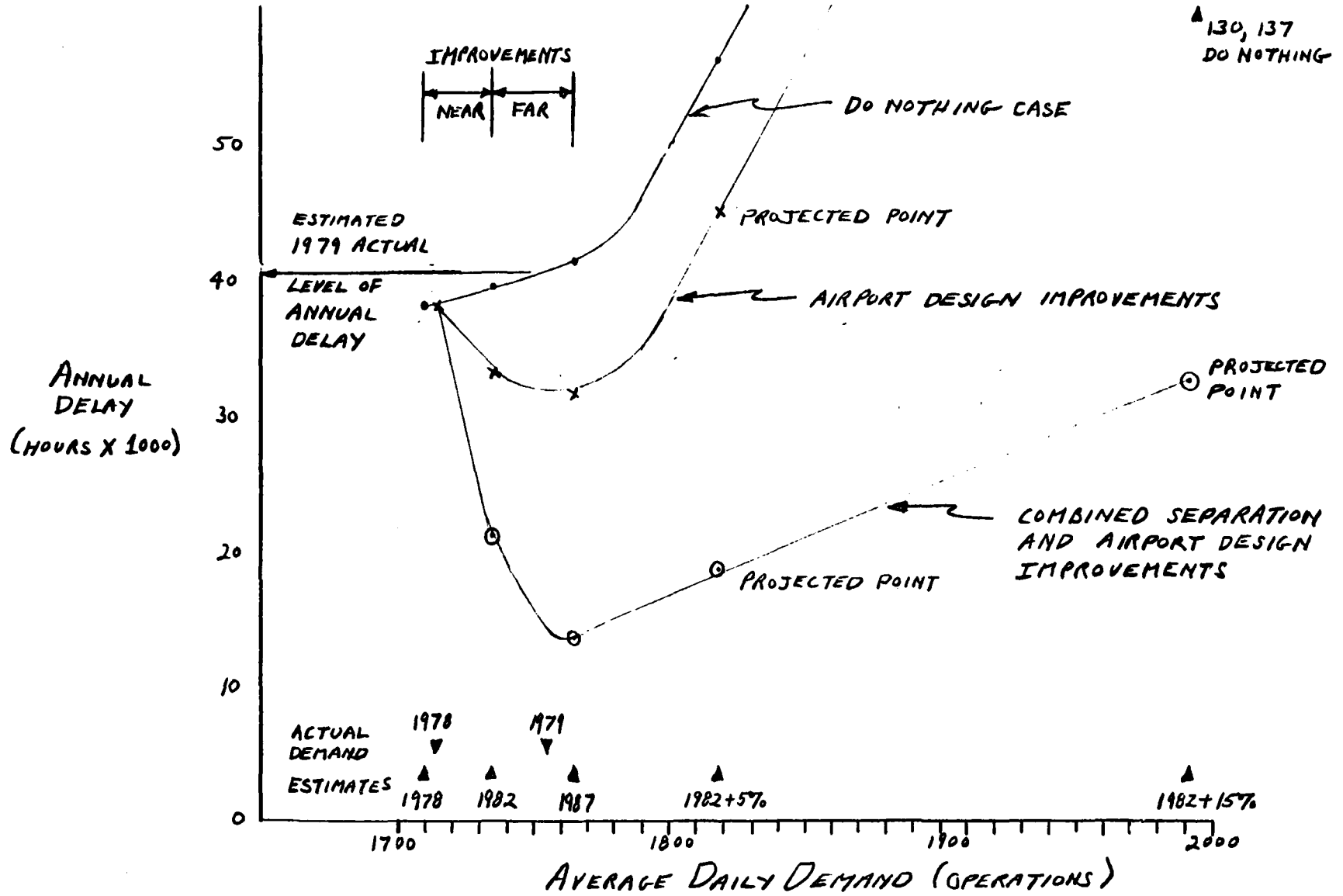

FIGURE 15 Summary of Annual Delay Estimates